UNITED STATES OF AMERICA

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DEPARTMENT OF TRANSPORTATION

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FEDERAL AVIATION ADMINISTRATION
ASSOCIATE ADMINISTRATOR FOR
COMMERCIAL SPACE TRANSPORTATION

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SIXTH ANNUAL COMMERCIAL SPACE TRANSPORTATION FORECAST CONFERENCE

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WEDNESDAY,
FEBRUARY 12, 2003

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The conference was held at 9:00 a.m. in the Ballroom of the Fairmont Hotel, 2401 M Street, N.W. Washington, D.C., Patti Grace Smith, Associate Administrator for Commercial Space Transportation, presiding.

PRESENT:

AL KOLLER
HIROTOSHI KUBOTA
DONALD R. MMONAGLE
MISUZU ONUKI
JAMES PAGLIASOTTI
OREN PHILLIPS
EDWIN J. PRIOR
DIANNE SAKAGUCHI
FRANK SIETZEN
DARREN M. SKELLY
JULIE A. VAN KLEEK
VICTOR J. VILLNARD
BOB WALKER
BYRON WOOD

PRESENT FROM FAA:

PATRICIA GRACE SMITH
KELVIN COLEMAN
HUGH COOK
CAMILLA MCARTHUR
MICHELLE MURRAY
DANIEL P. SALVANO

A-G-E-N-D-A

P-R-O-C-E-E-D-I-N-G-S

9:05 a.m.

MODERATOR MURRAY: Good morning. I would like to welcome everyone back to the second day of the sixth annual Commercial Space Transportation Forecast Conference.

My name is Michelle Murray, and I'm an aerospace engineer with the Space Systems Development Division of AST, and I'm going to be your moderator for the day.

This morning we have -- I would like to introduce Patti Grace Smith, our Associate Administrator for Commercial Space Transportation.

MS. SMITH: Good morning, everybody. I hope everybody had a good evening last night, especially for those who have come to the land of snow, snow flurries, and cold.

I have been hearing that a number of people, since they got here, have gotten colds, and things like that. We are really sorry about that. But hopefully you will appreciate the change of seasons, and this is a little different from where you may have come from.

We would like to be where it is sunny right now, where there is some sand, and water, and that kind of stuff, around.

It is a great pleasure, my great pleasure this morning, to introduce today's keynote speaker, the Honorable Bob Walker. A man I'm sure is known to everyone here.

Bob's name has been associated with commercial space transportation, and the Commercial Space Launch Act of 1984. As a member of the House Committee on Science and Technology, as it was known at that time.

This, of course, is the basic Act under which my office has been organized, and under which the U.S. commercial launch industry has been regulated and encouraged.

He capped a distinguished congressional career as chairman of that committee. But he has continued to be a strong advocate, a very strong advocate, of commercial space activity and innovation.

He most recently served as President Bush's appointed chairman of the Commission, the Commission on the Future of the U.S. Aerospace Industry, which completed its work in November.

Bob did such an extraordinary job that I learned, this morning, that the President tapped him to head a commission that is reviewing the U.S. Postal

Service.

He is a very flexible man with lots of capabilities, obviously, to go from space to postal service.

Please help me welcome a true friend, and a champion of the industry, Bob Walker.

MR. WALKER: From the orbital express to the pony express. So all in one year.

Well, thank you very much. I'm delighted to be with you, and thank you. I noticed, as Patty went through all of that list of accomplishments, a few skeptical faces in the audience.

I'm reminded of the story of the guy who is walking down the street and sees a sign that say, talking dog for sale. And he does a kind of a double take and walks up to the door of the owner and says, I see you have a talking dog for sale. The owner says, yes, he is in the backyard.

The guy goes into the back yard, there is a mutt back there. And he looks at him, he says, are you the talking dog? And the mutt says yes. And the fellow says, what is your story? And the mutt says, well I learned I had this talent very early in life.

I decided I wanted to serve my country, so I went and talked to the CIA, they made me into one of their agents. He said, I would sit in on meetings of meetings of heads of state, and lots of people, and so on.

I would listen in, nobody thought that a dog could ever relate anything, so I became one of their top spies for several years running. But I got tired of all the travel involved with that so, he said, I went on airport security detail.

And he said, I would sidle up to people who looked suspicious and, he said, I won several medals on that. Then I got tired of that so, he said, I settled down, I got married, and I raised a litter of pups, and here I am.

And the fellow is really impressed. So he goes to the owner and he says, how much do you want for that dog? And the guy says 10 dollars. He says, 10 dollars? He says, that is an absolutely amazing dog. and the owner says, he is such a liar, he didn't do any of that stuff.

Well, this morning I did at least some of that stuff. And I appreciate the opportunity to be with you.

You are meeting here at a very interesting time in space history, and in particularly in commercial space history, because we are faced with a number of different things happening that will have very important implications for the future.

First of all, certainly, the entire space community is wrestling with the shock and grief over the loss of the Columbia. And today on Capital Hill, with Sean O'Keefe testifying, we will begin sorting out some of the public policy questions related to that.

And it seems to me that we do that in a little different atmosphere than was there when I was in Congress, during the Challenger accident, and we were sorting that out.

Because I think NASA has responded to this tragedy in a very positive way. The fact that they began providing the public with all of the information that they had, very early on in the crisis; the fact that they stood up an investigation committee, an independent investigation committee with highly qualified people, very, very early, I think provides a base of public policy discussion which is very different than what happened after Challenger.

And that is not to criticize the people who were in place during Challenger, it is simply that they had never coped with anything like that before.

And what we learned out of that was the need for the kind of actions that NASA has now taken.

So, hopefully, we will avoid some of the long period of recrimination that took place after Challenger.

We will figure out what went wrong, and we will move on, and begin flying again. But the fact is that we are going to have a period of time here to sort through some of those public policy issues.

And, as I say, we will get a little bit of impression about what is going to happen in that area, as Sean O'Keefe goes through his testimony today.

But there are a number of implications of all of this, for NASA going forward, that I think we have to reflect on, as people interested in commercial space activity.

First of all there is the question of how long it will be before the shuttle can fly; how long will it take to find the problem and get it fixed.

And that is, I think, an important question, because it will mean that there will be a shuffling here of trying to figure out how space access will be accomplished if you do not have the ability to rely upon the shuttle, particularly in questions as it relates to the space station.

Do we have to form closer ties to the Russians, to make more use of some of their craft? Does that mean, then, that the Russians will be able to build some craft that could have implications for the commercial market?

And are investors that some of your companies are looking at, will they in fact all of a sudden face some competition in the world that they didn't anticipate as they looked at your business plans?

And I think it is also important to recognize that there was a budget amendment sent forward by NASA that also anticipated the need to do some things differently in the future.

And we shouldn't ignore the facility that some of those plans may actually be moved forward as a result of the loss of Columbia. In particular the plan to build an orbital space plane and fly it, at least initially, aboard the EELVs that the Air Force has previously put in place.

Now, that is easier said than done. Clearly the EELVs were not built as human rated craft, and so they would have to get that kind of rating before you could fly space planes aboard them.

But the fact is that this is an opportunity to, perhaps, get some use for those EELVs that was anticipated to be in the commercial market, and has not panned out. The loss of satellite business certainly impacted the ability to get the kind of financing for

EELVs that was originally anticipated.

And so both Boeing and Lockheed are bleeding money at the present time in that program. And so a NASA use for it would certainly be welcomed by the people who have that on their plate.

But the interesting thing, I think, about the orbital space plane, it was reelected in the amendment that went to Capitol Hill, is the fact that it anticipates being more than simply a launch for crew aboard EELVs, but it also is anticipated to be the second stage of a two stage fully reusable vehicle in the future.

And I want to mention this because it fits with some things that our Commission really thought were important going forward, if you are going to have a viable space program, particular a commercial space program.

And that is, as you go through these development stages, you have to have a lot of interagency cooperation. This two-stage-to-orbit vehicle will largely be a cooperation between NASA and DOD.

With NASA building the orbital space plane that will serve, first of all, as a crew access and return vehicle. But also would be a crew rescue vehicle, to be used aboard the station.

But, secondly, it anticipates the use of the DOD's National Aerospace Initiative, which is aimed at building a hypersonic craft that will be used for a variety of defense missions, but also could be used as the first stage of a two stage-to-orbit vehicle.

And so if you can get that interagency cooperation you can use money much better, inside government, and you can get a capability that meets both NASA's needs, and Defense needs.

The other thing that I think is important to recognize, in the NASA budget going forward, is the fact that they have committed themselves to some new generation technology for on-orbit use.

And this could end up being important to those of you looking at commercial markets. And that is, upgrades in power and propulsion. The Commission, again, recommended that this is a direction that NASA go.

That as they design missions to the future, rather than looking at where they want to go in space, they ought to look at what are the capabilities that we can put together, as a nation, that gives us the ability to do a number of different missions, as Congress appropriates the money to do them.

And, in particular, we recommended that they do far more in the area of power and propulsion. First of all we believe that if you want to get to places like Mars, and Europa, and some of those wonderful places, for the future, what you have to have is a capability to actually have power to get there.

That you can't simply drift there and create the political imperative to go. As long as the trip to Mars takes months it is going to be very easily dismissed as a part of the congressional appropriations process.

When it becomes a matter of weeks it is much harder to dismiss. And so creating the technologies that allows you to do that, does create an imperative, of sorts, to get it done.

But the ability to use nuclear plasma beyond orbit is certainly something, then, that becomes a power capability that may have great implications for the future.

For instance, some of you have heard me talk before about the fact that if you could do it at some point in the future, the creation of a space utility, utilizing some sort of power source that would microwave energy to on-orbit assets could be a defense capability that would be very, very interesting, but would also have tremendous capabilities if you wanted to, for instance, build a space industrial park going forward.

Now, having given you kind of that view of some of the things happening inside NASA, let me also say that the aerospace industry has some severe problems and challenges just ahead, as well, both in-air and space. It was one of the key findings of our Commission.

First of all there are major financial concerns. There is a lack of capital. Now, that has been somewhat ameliorated for some aerospace companies by the buildup in defense.

But as all of you probably realize, the problem in the defense side of it is that it tends to be highly cyclical. And the investors on Wall Street understand that, and realize that this may be a fairly temporary kind of upswing.

And so we have not solved all of the underlying financial problems inside the industry, and the lack of access to capital markets. Therefore if you take a look at what the Aerospace Commission recommended, you will see that one of the things we thought was important was to look at a new business plan in aerospace, that anticipates the kind of tax policy, and the kind of global policies, that will attract more capital into the industry.

We don't believe that you can finance the entire space future, or the aerospace future, out of government revenues. That you have to have the kind of business plan that ultimately brings money from capital markets into the programs, and allows you to have a clear road to move forward.

On the financial side, it is not helping that the airlines are going broke. And that is a very difficult circumstance over the next several months, because they represent an ability to buy aerospace products and, particularly, to keep a lot of suppliers alive.

And that has an impact throughout the air and space arena, when the airlines are in the kind of financial difficulty that they are now in.

And I mentioned, previously, the satellite business certainly hasn't panned out the way we thought it might when we were meeting here a few years ago.

There was an anticipation at that time of hundreds of satellites flying in constellations that were all going to be launched aboard all of these space vehicles, and companies built whole business plans around that, including the Air Force, which got Boeing and Lockheed to invest in the EELVs, in the anticipation of that kind of business. It has not panned out and it is certainly an underlying financial problem for the entire industry.

We also face, in addition to financial problems, very real threats in global competition. We spent a lot of time talking to the Europeans, the Japanese, the Chinese, and we found that the United States had better wake up and realize that in the commercial aircraft area, the Europeans are coming after us like gangbusters.

And they intend to beat Boeing at every sale over the next several years. And they are aggressively moving with new technologies, and with finance structures, that makes it very hard for us to compete.

And we need to recognize that, wake up as a nation, and try to make corrections to assure that we continue to lead in global competitions.

And perhaps the greatest threat coming from the Europeans at the present time that affects, again, our commercial markets for the future, is Galileo. Because Galileo is not simply their alternative for the GPS systems in this country, it is that, certainly.

But it also is the basis for their own view of air traffic management in the future. And that has huge implications, because they could begin to set the standards and regulations for air traffic management, unless we get ahead of that curve, and put the next generation of air traffic management into place so that the United States has the ability to lead the world.

In China we are being challenged in a big way in space there, and they are making major investments. This is not in the Commission report, you are hearing Bob Walker's conclusion, after spending a year at this.

But I believe that the Chinese are engaged not just in a human space program, but on a moon program. And I believe that within a decade, that they will land on the moon, and will say that they are there to stay permanently.

That is a very, very important challenge for us, not only from the standpoint of technology, but the political and psychological affects of that will be enormous.

And if you want some proof of that, when we were at Star City, as a part of our Commission activities, the crew changing in the extravehicular activity pool that day, was a Chinese crew.

Now, you don't change -- you don't do EVA activities unless you are planning on being outside the space craft, probably building something. And so that was an interesting piece of the learning curve that we had, that came somewhat unexpectedly.

I had a Japanese parliamentarian in to see me the other day, who is head of the Science and Technology Committee in Parliament. And I said to him that my conclusion was that the Chinese would be on the moon within a decade.

And he said, no, you are wrong. And I was a little surprised by that. And he said, no, you are right in concept but, he said, they will be there within three or four years, which somewhat surprised me, because I think that is a very compressed time frame, but it depends upon how much investment that they are willing to make.

And third bit of evidence, one of our key Commerce Department officials was over in India, recently, and was talking to the Indians about their moon program.

And one of his questions to them was, you know, why are you engaged in the moon program in India? And the answer was, because the Chinese are.

Now, I mean, the fact is that these are things that mean that the Chinese will be developing technologies that will be competitive, then, not only as a national interest question for them, but be ultimately competitive in the commercial marketplace, as well, and we need to recognize that. So as a Commission what we did was we recommended, for example, that the United States move ahead aggressively toward developing a new air traffic management program, to give us the capacity to meet our air traffic needs in the future.

But also to recognize that in the future you are going to have air and space vehicles in the environment. Somewhere along the line the technology that we have in place for air traffic management needs to have a recognition of that.

We also recognize that in the future you are going to have both manned and unmanned vehicles operating in the same air space. We need to have the ability, inside an air traffic management system, to deal with that.

And so we think it is extremely important that the nation begin investment on that. That is one of the things I'm going to be talking about when I go before the Aviation Subcommittee this afternoon.

We also recommended a heavy investment in R&D in this country. We have not done the kinds of things that we need to do to assure that the underpinning of research and development in our country gives us the ability to do better things in our air and space activities.

Let me just, then, briefly talk about what I think the road ahead looks like. Our Commission used as its vision and, ultimately, the title of our report, Anyone, Anything, Any Time, Anywhere.

Because we believe that in the course of this century we are going to be able to move people and goods, and munitions, and all kinds of important items for our national interest, around the world, instantly.

We are going to be able to have greater access to space, we are going to be able to do a lot of things. And the question is, what are the underpinnings, what are the foundations you begin to lay in place, right now, in order to have that done?

If you look at the nine chapters of our report, each of those things represents the building block of a foundation, of the underpinnings, to be able to do anyone, anything, any time, anywhere.

There are a few things happening that, I believe, begin to fit that picture. For instance, the X-prize competition that is ongoing. I think that that is a real competition.

It has, certainly, a lot of interest, over

20 companies that are involved in it, at the present time. It is a competition that is developing some very unique technologies.

I happen to be in a place to see some of the proprietary work that is being done in order to support some of that X-prize competition and I can tell you there are some exciting things happening out there, in that venue.

What it probably means for the future is that if it is successful, and some people believe that there will be a successful completion, and a winning of the program within 12 to 24 months, then that probably is the best venue for the space tourism, that I know that you've talked a lot about here.

I think in light of Columbia, that NASA is not going to be in the space tourism business any time in the near future. The one thing that is going to come out of whatever public policy decisions we are making, after this, it is going to be far harder to move them towards a space tourism sort of conclusion.

But if we get a successful X-prize competitor, that could be the route that you get there. And it also presents challenges for FAA that I think you talked a little bit about yesterday.

I mean, if these guys are actually going to fly here within 12 to 24 months, the questions will be, you know, what is the process for allowing that to happen, and then what is the process for allowing the build-out that would actually put, then, people aboard those craft to take them to low orbit, at some point in the future.

The other thing that I would say that the road ahead very much needs is interagency cooperation and coordination. If you look at one of the main conclusions of our Commission report, you will find that we believe that the fundamental problem in the way in which government is dealing with the space industry at the present time, is the fact that it is dealing far too much within its own vertical stovepipes.

That there is no horizontal cut, that the agencies don't talk to each other. As a result there is massive misuse of resources. The government has, in fact, become in many ways dysfunctional as it relates to technological development.

And we believe that there has to be far more in the way of communication and cooperation among agencies, as I said, that we are anticipating can be done as we go about building a two-stage-to-orbit fully reusable vehicle.

If we can get the kind of cooperation that gets us there, that would be a step in the right direction. But we need a lot more of it in the months and years ahead.

Well, at a time of challenge, the road ahead looks more difficult than ever. But the challenges often produce extraordinary steps forward.

As we mourn the loss of the brave crew of the Columbia, for example, let us be grateful for the inspiration that they provided for us to go on, as well as for the aftermath of the tragedy, which has caused much of America to recommit itself to a future in space.

Thank you very much, I would be happy to take a couple of questions.

(Applause.)

MODERATOR MURRAY: And just as a reminder, please state your name and your affiliation when you are asking a question.

MR. JACKSON: Again, I'm Stuart Jackson, Office of Commercial Space Transportation, AST.

The question I would like to ask is that I remember myself, as a kid, I thought one of the greatest thing that we've done, dealing with space was the idea of coming from practically a blank sheet of paper to develop the entire program to go to the moon, and succeed in doing that within the time that President

Kennedy set.

And we did it, you know, very structurally. We had to develop new equipment, we had to do a lot of testing, so it was really an era that, I think, all Americans can totally appreciate.

But I think what we are lacking here, today, is that same hunger and that same drive towards something that should be here for the rest of my life, my child's life, my grandchildren, etcetera.

How can we get that drive put back into the U.S.? And I'm not just saying for the people in this conference, right now, for the industry, but for everyone looking at that need, and that drive, and seeing the benefit of the entire space program?

MR. WALKER: Okay, well, a couple of answers to that. I mean, first of all, one of the reasons why we did the space program in the 1960s is because we were afraid that the Russians were going to get there first.

And so the fact is that a lot of it was a national interest investment, and we were willing to put huge amounts of money toward building all of that.

So my guess is that a positive that would come out of a serious understanding that the Chinese were about to go to the moon, might be a reaffirmation that the United States better do the things that keeps hitting the forefront, and look to missions that would leapfrog the Chinese.

But if you want to get there, that is one of the reasons for investing in the kind of technology that the Commission is talking about. If you invest in propulsion technology that allows you to move faster on the way to places in the solar system, it gives you many, many options in the future for missions that Congress might end up being willing to designate money for.

So if you really want to get to Mars, it would certainly help to have in place the ability to go there quickly. And so our view was, on the Commission, that the way in which you create the imperative that gets the financial resources that will allow you to do big new missions, is to work very, very hard at creating technologies that then allow you to do exciting things.

Yes?

MR. SHOME: My name is Pradipta Shome from AST-300, Office of Commercial Space Transportation.

And with regard to Galileo, you mentioned that it is not a substitute for GPS only, but there are VFR traffic management. Could you elaborate on that a little bit?

MR. WALKER: Absolutely. I mean,

fundamental to any air traffic management, new generations of air traffic management, is a navigation control and surveillance systems.

And the first piece of that has to be the navigation piece. And so the fact is that building their own capability to do navigation will allow them to have the base in place to then design an air traffic management system with both ground-based and space-based elements that would do the surveillance and control pieces as well.

We have to do this. I mean, the fact is the world needs a different air traffic management approach at the present time. Fifty years of having air traffic management being done by voice communications between controllers, and pilots, simply will not fit, when you just look at the number of planes that could be introduced into the system in the near future.

When FAA came before the Commission and testified we said to them, after you are finished with the OEP program, would you be able to handle anywhere from 20 to 50,000 new aircraft operating as air taxis in the system? The answer was no.

So the fact is that we have to have it. The question is whether we are going to build it, or whether somebody else is going to build it. Our conclusion is that the Europeans are determined to build it.

When they talk about Galileo, they are talking about it being a profit-making operation. Well, think about this for a minute. How do you make a profit with a system that is competing against something that is offered for free? You don't.

And the only way that it becomes a profit-making system is if you require everybody who is flying into your airspace to utilize your air traffic management system, based upon your Galileo.

That is where they are going, folks. And, you know, it is a challenge for us. It is a challenge I think we are perfectly capable of meeting, but we better begin doing the investment now, necessary to get us there.

Now, the good news is that the Defense Department, for their own purposes, are building whole systems of control, surveillance, and navigation.

If we can figure out a way, again, with some interagency cooperation, to put civilian components aboard those systems, that would allow us to use them not only for the defense mission, but ultimately for the air traffic mission we could, in fact, marshall the investment that is now going to be made there, anyway, in a way that gives us a new capability in a relatively near term scenario.

Certainly much nearer term than what the Europeans are looking at. We, on the Commission, thought that that was a great hope for getting us where we have to go.

MODERATOR MURRAY: One more question.

MR. LARSEN: Office of Commercial Space Transportation Space Systems Development Division.

I'm curious, I would like to get some suggestions from you on the interagency cooperation and coordination. You have the National Space Council, OSTP, coordinates a lot of the things now.

What else can we do, what more can we do to get more cooperation, coordination?

MR. WALKER: You can look at chapter 6 of the Commission report. And here is what we suggested.

We suggested that every department and agency, and most agencies, not every agency, but most agencies, put in place an office of aerospace development.

And the idea behind that was to align the missions of agencies with aerospace. The fact is that most agencies have some aerospace activities going on, anyway, but they are not in any way coordinating it.

Our feeling is that once you get all of those offices in place, that what you would then need, inside of the office of Management and Budget, would be an office of aerospace coordination to see to it that they are all operating off a similar policy.

And we put that together with a policy coordinating council inside the White House, that would actually determine the policy that was being pushed down through the agencies.

What you get out of this is you get every committee on Capitol Hill with some jurisdiction in aerospace. And so you spread the idea that aerospace is important, inside the economy, through that mechanism.

And then we suggested, on Capitol Hill, that they put together a joint committee on aerospace, to coordinate all of the activities that are happening there.

Now, that sounds like a very complex system that we've created. We've created a complex system for this reason. If we had suggested putting together, say, a department of aerospace, or something like that, you would never get there. It is politically impossible to do.

You rob power from some people, and give it to somebody else. And unless you have a crisis that creates something like the Department of Homeland Security, you are not going to get there.

But what we have done with this particular pattern is, we have created a pattern that empowers everybody. You give new power to everybody across the board.

And so in empowerment we think that you can get cooperation, and coordination. And so we put together a pattern designed to empower Congress, designed to empower agencies, but ultimately get everybody talking off the same page.

MS. SMITH: I have a question.

The first question is, with the Bush administration having indicated that one of its national imperatives is assured access to space, what role do you see entrepreneurial large companies playing in the near term, in terms of achieving that?

And the second question is, what do you see as the role of non-federal launch sites, tying into delivering assured access?

MR. WALKER: Well, I think that in most instances their commitment to assured access is largely a defense related commitment at the present time.

And it seems to me that what companies can bring to the table is some of these new technologies. I mean, if companies bring in some ideas for much cheaper launch capacity, for example, that is going to be something that the Defense Department is going to be looking at.

People at DARPA, people at DDR&E, all over the defense establishment, right now, they are looking for the kinds of technologies that will give them, obviously, reliability.

But, secondly, can do a variety of missions at lower costs. And you have missions for everything from relatively small loads to heavy loads.

In the future, probably, EELV is going to fill all the gaps for heavy loads. It is a lot of the small applications, the micro satellite applications of the future, that there is a real place for a commercial launch industry to begin to look at playing in.

And, I have forgotten the second part of your question.

MS. SMITH: The non-federal launch sites.

MR. WALKER: Yes, the non-federal launch sites. I think there is a tremendous opportunity, then, if you go to these new generations of vehicles, that you would use non-federal launch sites for those.

I think that as you get to small vehicles, you can begin to look at the experience that NASA has had at Wallops Island, and so on, that there are -- that you have the ability, at non-federal locations, to begin to emulate that, and utilize far more in the way of these smaller launch vehicles, as a part of the overall national infrastructure.

Thanks folks, nice to be with you.

(Applause.)

MODERATOR MURRAY: Thank you, Mr. Walker, for an extremely interesting point of view, and very enlightening.

Our next panel is titled, Future Space Architecture. The moderator for this panel is Mr. Hugh Cook.

Hugh Cook, division manager for our systems engineering and training division, is responsible for safety standards, methods of verification, staff training, and consultative engineering support to the other divisions.

He has been with the FAA for two years, prior to his appointment to the FAA Mr. Cook spent 20 years in aerospace engineering, including the last 15, in design, manufacture, and launch of commercial launch vehicles.

MR. COOK: Thank you, Michelle. We in AST love this conference. It is our time to put some muscle and sweat and to encourage, facilitate, and promote charter that we have in the Commercial Space Launch Act.

My panel, Space Architecture, hopes to draw attention to various works under way across the industry, that may be able to reduce costs of space transportation.

These programs and projects span the entire range of technical readiness, from just starting to think about it, to thousands of them out there, flying right now.

Our panelists are active leaders in these efforts, and I would like you to please welcome Dr. Dianne Sakaguchi, project lead with the chief engineer's office for satellite and launch control at the Aerospace Corporation. She will discuss ongoing efforts to use GPS metric tracking in range safety applications.

Dan Salvano, director of the office of communications, navigations, and surveillance systems at FAA, he will discuss an FAA initiative of currently deployed GPS tracking systems, known as ADS-B.

And I want to draw everyone's attention to FAA, ADS-B, because the kinds of unit dollar costs for GPS tracking that they are achieving in this arena is orders of magnitude below the kinds of costs that people have thought and projected in other GPS tracking areas.

So this is a very important point, and Dan has graciously spoken at our COMSTAC, and now this, I want to be listening to what he is saying. Thank you.

We are also joined by Vic Villhard, an associate with Booz, Allen, Hamilton, in their Colorado Springs office. He served in the U.S. Air Force in a series of progressively responsible positions, culminating in a four year stint at the OSTP.

And he has long been one of our best booster, fan, and supporters, here at the Office of Commercial Space Transportation.

And we are joined by Darren Skelly, program manager for NASA's Range Technology Development. In this role he leads the Advanced Range Technology Working Group, which is a large scale collaboration, working to develop technology road maps to the future ranges.

So with that I will turn it over to Diane.

MS. SAKAGUCHI: I'd like to talk to you, today, about both planned and potential changes to our two national space launch ranges, the two major ranges.

I borrowed a mission statement from the Air Force organization that I support. The Air Force organization that I support is responsible for acquiring and sustaining the infrastructure for the eastern and western range, Cape Canaveral and Vandenberg Air Force

Base is how you may know them.

Now, we have a lot of customers. We worry just as much about our commercial customers, our NASA customers, as about DOD. Although DOD is the primary source of funding, and has most of the launches at both ranges.

I would like you to notice two things about the mission statement. One, that we are planning to go to a space-centric range. We don't know, yet, the details of that.

We have not selected space assets, we don't know, exactly, what is going to remain on the ground. But we are committed to the goal of moving the range infrastructure, primarily, to space.

The other part of the mission statement that is important to note, is that we need to sustain our current capability, while we migrate. It is always difficult to make changes to an operational system.

We have to make sure that all of our users will have the ability to launch, as we make changes, and after we make changes. Right now the eastern range is in a down time while we switch over to a new, better, we hope safer system, that is a slight interruption to launch.

We plan to minimize any interruptions, but it is difficult to put in new technologically different systems, while maintaining a capability, and maintaining a safe cost-effective capability.

The picture shows some of the systems that we do acquire and maintain. One picture is a command site at Antigua. It is used, if we ever need to send a destruct command. You see a radar from Patrick, and you see a launch of one of the Titan boosters.

Next chart, please. This depicts the area of responsibility for our ranges. It is much more than just the launch pads, or the launch sites. You will see the depiction of several of the trajectories.

Ballistic missiles from Vandenberg tend to go out over the Pacific ocean towards Kwajalein. The space lift launches tend to be in a southerly direction, because they go to highly inclined orbits.

On the east coast you have at least two different types of space launches, and still a different trajectory for ballistics. So it is important to have command sites, radar sites, telemetry sites, for all of these various types of missions.

It means that we have to cover a very wide geographic area. That will be one of the reasons for going to space, eventually, is that we can cover a much wider area, while having less total infrastructure.

Next chart, please. We plan, we have near-term plans in place, and that is to go to GPS metric traffic. There are other things that are potential changes for the long term.

And these changes may or may not occur. They are considered, at the moment, as goals. We don't have funding, we don't have plans, we don't have a way, yet, to get there.

The long term plans include autonomous flight termination, that is sometimes called destruct, but termination is really a more, that is a better term for it.

And another would be space-based relay of commanding and telemetry. Both range safety, and the mission telemetry. Some of that is already being done through TDRSS. But we cannot bring back the vast amounts of mission assurance type data that the launch vehicles, especially EELV now requests.

TDRSS is not yet capable of handling that. And there are, also, problems in using TDRSS for such things as range safety, commanding, at the moment.

So we are trying to reduce the costs, the national costs of the infrastructure. We would like to, eventually, get to a point where we can eliminate a number of the radars. I will show you a bit more in a moment, about how many of the radars, but eliminate some of the radars, some of the -- at least some of, or all of the telemetry and commanding antennas.

Those are expensive to maintain, very expensive to maintain, and space, we hope, will offer a cheaper and more flexible alternative.

This shows our plans for eliminating some of the radars. When we talk about closing down the radars, we do have a lot of people ask, well, are we going to get rid of all of them? And the answer is no.

What we are now planning to do, and even this is always subject to future change, is we are planning to eliminate three of the radars on the east coast, and eight of them on the west coast.

On each coast we will be maintaining a launch head radar called MOTR, multiple object tracking radar. That will stay, at least.

Also on the east coast there are three radars important to NASA. NASA may take responsibility for those. Those are planned to stay. And three other radars used for space object tracking and for ballistics, those are planned to stay.

So that gives us seven remaining on the east coast. We are planning to keep two MOTR, and one at Kaena point in Hawaii, on the west coast. The ones with the little red circles, and the lines through them, are those that we plan to eliminate.

GPS is planning to provide a number of benefits in addition to just costs. Eliminating the radars will save us a great deal of costs. GPS will also give us much more accuracy than radar, and that should provide benefits, independent benefits for the launch vehicles.

It is also a first step to go to space. The air traffic control of the future that was talked about, is not going to work terribly well if it is based upon fixed ground radars.

You could not have launches from a range in the middle of the country, Oklahoma or somewhere, unless you built a whole ground radar system, and that is not intended.

So we think it is in the nation's best interest to go to GPS for range safety traffic. That is to tell the range safety officers just where the vehicle is, so that they will know whether it is posing any sort of safety hazard to the public.

Next chart. This is a notional plan. This may or may not happen with the date shown. Take it as what we are marching to at the moment, but subject to change.

The first line shows EELVs plans. EELV has actually begun working with Boeing and Lockheed Martin to investigate going to GPS. They have identified a number of issues, we don't have solutions to all of the issues yet, that is phase one.

Phase one is almost complete. Phase two is expected to kick off next month. They know what the requirements are. There are discussions that have to be done with range safety, they are trying to finalize the cost numbers, but they are underway, we think they are going to get there, we think they are going to have a completely certified system that is approved for safety purposes by 2007.

The ground system is further underway than the airborne systems. We have a GPS capability built at both ranges. There's some other infrastructure which has to be completed before we can use the GPS that we built.

But it will be ready before the EELVs, at least, are ready. The lead organization, or the most forward of our vehicles, though, are our ballistics.

Ballistics capability is already in place using GPS metric. In this case GPS metric tracking capability is provided by GPS translates, rather than GPS receivers.

But the capability is already in place on the east coast. On the west coast we expect certification launches for the ballistics, Minuteman III, to be exact, in 2004.

Once those certification launches are complete, we will have what we call a certified system for ballistics. It does not mean that we have a certified system for other launch vehicles, the technology is a bit different than the launch vehicles, and some of the problems are a bit different.

The radar shutdown could not be completed until all vehicles use GPS metric tracking. We would otherwise be left without a safety tracking source for the other vehicles. We need two, range safety requires two independent sources.

And right now those two sources are radar and guidance telemetry for vehicles. So if we get rid of the radar, and we have the guidance tracking, which we plan to continue to use, we need one other source, and that is planned GPS metric tracking.

But until everyone is there the radars will not, cannot, close. This is the earliest possible date we would have.

Challenges. Two primary challenges are funding. The first two bullets shown there are both funding. Our funding is being cut. DOD has many, many uses for their funds these days. And not certain that they will continue to have the funds that we need to develop the infrastructure to support GPS metric tracking.

We should know, in a few months, whether we are going to have the money, and whether we are going to have it now. Potentially this project would have to be delayed several years.

The other issue that we are dealing with, mostly with EELV, is very high potential cost for launch vehicles. Launch vehicles have significantly greater challenges than aircraft, in using GPS metric tracking.

The high dynamics of the launch vehicles tend to confuse most GPS receivers. Now, some of the receivers have been built, and have been demonstrated to be able to handle the dynamics of the launch vehicles.

But in the initial attempts to use GPS onboard launch vehicles, the receivers tended to lose lock on the GPS, and not be able to say where they were any more. The GPS were no longer sending back reliable signals to the ground saying, okay, here is where the launch vehicle is.

That is, of course, totally unacceptable. There are solutions to it, we began to prove the solutions work. But it is not possible to take GPS from, say, an aircraft just put it on the launch vehicle and say, there, it works. It doesn't, we've shown that much.

So we will know better once the EELV receivers come in with their cost from phase one of the study, the study that was shown on the schedule chart, whether or not this is financially feasible.

Certification, certification as I said before means that we've proved, proved to range safety, proved to the vehicles that the new system does not possibly offer any harm, that it keeps the same level of safety that we have on ranges, that it doesn't impact mission assurance, at least impact mission assurance significantly.

That is something that we've heard from both Boeing and Lockheed Martin. They are concerned that if instead of radars we go to GPS metric tracking, that there could be a risk to their missions.

The boosters are important, the satellites are important, it is a big economic impact if we would ever lose a mission because of the range safety tracking.

So before we ever move in that direction, we have to make sure that we are preserving the mission, as well as preserving public safety, and that is going to be a team effort from everyone.

The other challenge is that GPS continues to evolve. We've discovered that our adversaries are beginning to use GPS against us. Right now GPS is relatively easy to jam. There are other weaknesses in the system.

The GPS JPO, the Air Force organization developing GPS, has planned a number of changes to GPS, which makes it much more jam resistant, provides other benefits.

But when they change GPS it means the airborne systems have to change, to take advantage of the new benefits of the system, and that the ground systems have to be changed, so that they are compatible with the airborne systems.

This will be a continuing challenge as we make GPS better and better, to get rid of some of the vulnerabilities, it is going to take time and effort to keep up with it, so that we maintain a level of safety, and we use the benefits provided by the changes to GPS.

Thank you.

(Applause.)

MR. COOK: Dan Salvano.

MR. SALVANO: Good morning. I think I

should have brought my GPS briefing today instead of my ADS briefing.

One of the many hats I wear in FAA is I also manage the program office for satellite navigation in the FAA. So we are working directly with the JPO.

We have issues on interference, jamming, losing of lock to new GPS modernization. I'm also with the FAA rep on the State Department that is having consultations with the EC on Galileo.

And unfortunately I can't tell you what is happening there, but that is an interesting exercise, some times, in futility. But interesting exercise.

But what I'm here, today, to talk about is automatic dependence surveillance-broadcast, ADSB, to kind of give you a sense of what we are doing in civil aviation using GPS technology, as augmented by WAAS, wide area augmentation system, which is the FAA augmentation system to civil aviation to improve safety in Alaska.

Next slide, please. Back in 1996 then Vice President Gore, announced a program to improve the fatal accident rate in Alaska. Alaska, if you have never been there, is a totally unique environment.

My first time there, it just blew me away in the sense of, growing up in the lower 48, you go to a village, a remote village, and the road starts at the center of the village, and end at end of the village.

And the only way to get from village to village is either by river, or by air. Pizza delivery, I was up in Bethel, where we have these, was by a Cessna 107, unless you made it yourself, about 100 miles of flight. It wasn't cheap.

So we started this to try to lower that accident rate. We worked with the industry, the RTCA, which is an Advisory Committee to the FAA. They form the Free Flight Steering Committee, and we mutually agreed to look at these types of technologies.

And maybe somewhat of an eye chart, but the ones with the Xs are the ones we are actively investigating. And what I'm going to focus in is in the air to ground surveillance coverage in non-radar airspace.

Next, please. One of the things that I want to talk about is we recently made, this past July, what we call the ADS-B link decision. That is what type of data link are we going to use to transmit data.

We decided that ADS-B will use a combination of what we call the 1090 megahertz extended squitter. That is an internationally recognized standard that we use today for secondary surveillance radar, a Mode-S transponders.

That will be used for air carrier aircraft, commercial operators, and the very high end of the business operations, folks that fly Cessnas, Challengers.

The second decision was something called universal access transceiver, which would be the ADS-B link for general aviation. Differing needs as far as data requirements.

The ADS-B airborne systems transmit an aircraft's identity, position, velocity, and intent of aircraft to air traffic control systems on the ground, thus allowing for common situational awareness to all appropriately equipped users in the national air space system.

One of the things we have to remember, we have primary radar, which you sweep, and you get an ident off the metal. Secondary surveillance radar, or with ADS-B, you have to be equipped to be seen by the secondary surveillance radar.

We are working this internationally through the United Nations ICAO, International Civil Aviation Organization. As a matter of fact, it was up there this past Monday. This fall there is a major conference looking at the future of civil aviation.

It is the Air Negative Commission, ATMC/CNS conference, and we are looking at things of where we go in digital communications, where we are going with navigation, satellite based versus ground based systems mix, where are we going with surveillance.

Let me talk a little bit about what ADS-B is. Basically for the aircraft, what you want is your own ship position. You can get that through GPS augmented by WAAS, relatively cheaply. Some aircraft can do that today with an INS, inertial navigation system.

Most of the air carriers that fly today across the pond need, are required by FAA, to have triple INS systems, and a flight management computer. You need your intent, or heading.

With GPS constantly updating your position you just take the derivative and you get a heading, a transponder to broadcast the heading, that intent, Mode-S transponder.

And a data link, what is the pipe in which you intend to do the transmission of that data. Primary radars, if it is an electronically scanned radar, have updates, rates, that can go below once a second.

But the typical terminal radars, and the N route radars that the FAA has is anywhere from four and a half seconds to twelve and a half seconds sweep rate. So you need several sweeps to generate a track. And I will have a picture of that.

And a primary radar doesn't give you the aircraft information as far as call sign, what type of aircraft it is, it just says that is an aircraft, or something out in that space.

This is a typical display that we have of the equipment that we have in Bethel. I will get into a little more detail on that.

This is some real time data. As you can see, August of 2000, in Bethel, what you have is the radar is at a 12 second scan rate, so you are seeing a ping every 12 seconds.

And what the controller typically sees is a ping, and then the track may jump, because it is 12 seconds, minimum, and then it gets processed through the computer. So those are the red dots.

The distance was about 130 miles, then the blue line in between is the ADS report data, and an update rate of once per second. As I said, this is a typical, this is the FAA test aircraft. It is a 727 that we have at our tech center in Atlantic City, which flew that test, I think that was the one I was actually on, 21st of August in 2000.

So what you see is a nice, solid, clear track for reporting purposes. And then that is what you see on the controller's radar scope. An overview, phase one, which is in the Bethel area of Alaska, that is southwest Alaska, typically, the Yukon, flat tundra.

We have 190 aircraft equipped with ADS-B equipment, which includes the transponders, the GPS receivers, and a flat panel display. We finished the first subphase of that, we are now updating that equipment.

Phase 2, we are going to go to southeast Alaska in the Juneau area, totally different terrain, very mountainous. Again, Juneau is a very tricky approach with water on three sides, mountains on two sides, does not have ILS, so it is a very tricky approach to get into.

Third phase looking at deploying that system state-wide, throughout Alaska. And then the possibility, then, of moving ADS-B into the lower 48.

As I said, we've nearly 200 aircraft equipped. We have ground-based units to provide communications. One of the things is for the controllers at Anchorage Center, that will be getting this information not only will they be getting the tracks of the aircraft to put on their screens, with identifiers that this is ADS-B tracks, not radar tracks.

They want to also be able to hear the communications, so we installed a network of ground-based transceivers to cover that distance. We had to modify the air traffic control host software to make those mitigating factors, so that the controllers knew what they were seeing, that it was not a primary radar ident.

We also put in some weather observation systems in that area, and that was all integrated into the computer for the air traffic controllers.

We worked with the users in the area. The phase 1 capability, we have approved standards through RTCA, we call them MOPS, minimum operation performance standards for the type of equipment, so that they can be certified by our aircraft certification folks to be used on real operating aircraft, so that they don't have to be put in an experimental condition.

We have, as I said, put in communication relays. We are going to put multilateration in there, since they have the transponders, so we can track the aircraft in the surface movement.

Next. This is some of the phase 2 back in the Juneau area. As I said, we are putting in some additional GBTs, ground broadcast transceivers. So the controllers can communicate with the aircraft.

One of the issues is operationally what do you want to do, be able to see those aircraft, but you also want to be able to communicate, to inject air traffic control commands to those aircraft, so we have to have the matching communication system, along with the surveillance system.

Again, the communication sites. We -- before I get off of this, I want to talk about what we are doing in the Ohio valleys. ADS-B application but a different spin to it.

The Cargo Airline Association had asked us to come in and take a look, they have unique needs. FedEx coming into, I think Louisville is their base. They basically own the night in Louisville, from about 9 p.m. to about 5 a.m., is when most of their cargo aircraft come in.

That is their central hub, so they need a precise landing schedule. And what we are doing, testing ADS-B, is spacing of aircraft. And the accuracies that we have can be used to space aircraft in marginal VFR weather.

The way our system is set up the shortest spacing is in VFR weather. When one aircraft can see another aircraft, so they can follow them in at, say, three miles distance.

As soon as you start getting some clouds, or haze, where you might lose that other aircraft for a minute or so, in haze or clouds as you descend, the air traffic control system starts opening up the gap, some times to five miles, or maybe even more, before it actually gets declared as IFR conditions.

We can see in an operation like UPS, when they have to get the aircraft on the ground, to a gate, start off-loading thousands of packages to send to their central sort, to sort, and then redistribute the packages to other aircraft as they go, that several minutes gap, or slowdown of the system, has a tremendous impact on their profit rate.

So we have done some testing in Ohio valley that is very good from the technology perspective, the problem being operationally how do we certify that to the level of integrity of the system, and integrity to the safety world has a specific meaning.

How do we certify that integrity, so that we don't have a hazardously misleading information come up? If a flag comes up and says my system is down in civil aviation, that has a meaning.

It may not be a safety of life issue because we have operational go-arounds, and workarounds, if you lose a particular instrument on an approach.

But what you don't want to have happen is the indication to the flight crew that that instrument is performing normally, and it gives misleading information that might result in an accident.

So that is where a lot of the dollars and delays, in the WAAS program we took an 18 month hit, because our certification folks were not happy with the way our contractor certified the integrity of the system.

So from your view of the world if you lose the system you lose the vehicle, integrity is very, very critical. Thank you.

(Applause.)

MR. COOK: Now we will hear from Vic Villhard.

MR. VILLHARD: Good morning, very glad to be here with you today, and I very much appreciate the opportunity to be able to tell you about some interesting work that we have been able to do over the last year and a half or so on modernizing ranges and building a strategic vision for where we think it makes sense to try to go with modernization of range capabilities.

So what I would like to tell you about is the results of a year-long study that we did on the extended range concept definition. And then talk about where the recommendations from that came out, based on an evaluation process that some of you helped participate in.

And then tell you about a range technology demonstration that we are at work, carrying out at Vandenberg Air Force Base, to take one of the first steps that we recommended, as a result of the study.

As background, you know, U.S. ranges support a whole variety of different types of activities, not just space launch, obviously, but a whole variety of test and evaluation activities, as well.

And, typically, ranges cooperate together to support, particularly test and even activities that span over a larger region than what one range can cover on its own.

And when I say ranges I mean the technical aspect of the range to provide the functions that you see listed there, not referring to the launch bases, or the infrastructure behind the launch bases, the launch pads, the roads, etcetera. So just the technical functions of the ranges.

The process that we used for the year long study started with putting together a task plan and presenting that to a variety of stakeholder organizations you see listed down the side of the chart there.

And then we put together the first phase of the activity, that ended up with the report that catalogued the mission support functions that we anticipate for future ranges, and I will tell you a little bit about the data from some of that, in another couple of charts.

The second thing we did was hosted a symposium, just about a year ago, in Colorado Springs to bring together some flight safety experts, and talk about space-based flight safety capabilities and some of the challenges and technologies that could be used in that capability.

The third thing we did was put together a description of various alternative future range architecture options, and we got about an 80 page report that describes, at the system level, what we assembled in terms of data to describe the different alternatives, and I will tell you a little bit about that.

And then the next thing we did was put together evaluation criteria, coordinated that informally with the stakeholder community, and evaluated the various options that we described in the previous report.

And from the result of that report came up with a recommendation. And what we did in the last report was put together the story on how you would move forward toward achieving that recommended future range architecture in terms of pursuing technologies and various demonstrations.

So here is just a list of the four reports that we put out. You see the hard copies here. They are also on a CD, much easier to carry around, since I've carried plenty of these around, and these two, and it is a lot easier.

So if anyone is interested in reading the details come see me, give me your contact info, I will be happy to get you the information electronically.

To talk a little bit about some of the range work projection data, we took the Air Force Base Command National Launch Forecast data, and counted up all the missions between FY'04 and FY'20, 2020, and we looked at how they shake out.

And you look at heavies, versus mediums, versus small for space launch projections. And, interestingly, you see that the activity is dominated by vehicles in the medium class.

But another interesting, I think to note from the data, is that sector commercial, NASA, and national security missions number just about the same over that aggregate period of time.

If you look at the split between the eastern and the western range, probably no great surprise here, but about three out of four of these space launch missions are scheduled to go from the eastern range.

On top of the space launch activity there is a whole variety of test and evaluation type missions that the two ranges support, and that other ranges support, as well.

And what we did is put together a relative workload model that describes how difficult it is for a range to support a particular type of mission.

So we gave relative weights to each of the different types of activities, based on actual workload data from the western range. And then we put together a model that showed, based on the projected levels of activity for each of the types of missions, how that total workload stacks up, in a relative sense, on the two ranges.

Interestingly the total workload on each range came up to just about the same level. But the interesting observation here is that on the eastern range space launch activity drives on the order of three fourths of the activity, sublaunch ballistic missile testing driving the remainder.

On the western range the ratio is just about inverted, where various tests and evaluation activities, aeronautical, ballistic missile defense as well as ICBM testing, make up about three quarters of the workload, and space launch drives the remainder.

So the proportions of the workload are just about flip-flopped from the eastern to the western range, in terms of space launch versus test and evaluation.

In the second part of the study we put together descriptions of various options for how you might modernize range capabilities for the future. And we looked at space-based options with GPS and IMU data as the baseline for the tracking capability.

We carried that through the other space-based, primarily, options that included also some ground-based instrumentation. And then we had a ground-based option that used either modernized radars, or passive coherent locator technology, also combined with either mobile or transportable assets, as an option.

In our study we combined the telemetry and commanding functions so that you would have a robust two way data link between the range capability and the flight vehicles that you are operating.

And the various options included GEO satellites, typically government owned, TDRSS, the large aperture satellite is a proposed capability out of SMC in LA; advanced wideband system refers to what has now been called the transformational communication system within DOD.

Then we looked at transportable or mobile assets for the telemetry and commanding functions in the second major option. And then in these two options we looked at either commercial LEO or MEO satellites, or commercial broadband satellite capabilities.

The evaluation criteria we assembled fell into ten different categories. We assigned relative weights based on interaction with the stakeholder group, for each of these evaluation criteria.

We had about a half page description to explain what we meant by each of these categories in terms of what new kinds of capabilities a future range would have, against each of these attributes.

And then we went through a process of describing each of the four major options in terms of what systems would be used. We also scored the baseline, which is the planned modernization program for the eastern and western ranges.

And as we went through the entire scoring process, assigning scores between 1 and 10 relative against each of these options, against each of the evaluation criteria, you can see how the total scores came out.

Blue were the best, green were the options that scored somewhere near the baseline, and then we had some that scored considerably lower, or just slightly lower than the baseline.

Bottom line from this is that we thought TDRSS and mobile assets looked like they would do extremely well against that overall aggregate set of criteria, which was based, again in part, on drivers that were derived from the mission support requirements that we projected for the future.

So what we came up to, as a conclusion as a result of that evaluation process, was that we thought a primarily space-centered range capability, supplemented by mobile assets, looked like it would be the best approach to give you improvements in flexibility, redundancy, capacity, expanded geographic coverage to support new mission areas like missile defense testing over broad areas of the Pacific ocean that aren't currently instrumented, as well as hypersonic vehicle testing that requires much greater geographic coverage than what we have with today's ranges or even development of reusable vehicles, or operation of reusable vehicles, for that matter.

Again, requiring range coverage in places where it doesn't exist today. So we thought this was a solution that looked like it made sense for the aggregate picture of what we think is expected to happen in the future.

As we went through the process of deciding and figuring out what were some of the opportunities and ways that you might want to try to move forward toward a vision like that, we came up with a whole variety of examples of activities that are under way, not necessarily for range improvements, specifically, but technologies and developments that are under way, in areas where there could be synergy and overlap that could help lead toward development of a capability that we just described, as a desirable end state for future ranges.

And you see listed here a whole variety of different examples. I will just point out a couple. But, obviously, there are big investments within DOD, particularly in UAV technology.

NASA has also done some extensive work in UAV development. And we think that is a good way to try to leverage some of those investments. And to take advantage of that in terms of being able to build and deploy mobile assets for range support.

The example for mobile asset could be the interest on the part of NORAD, the Army, more recently the Navy and the Coast Guard as well, in air ship development. FAA has even expressed some recent interest in air ships for deployment over the continental United States, fly above the weather, stay on station for extended periods, from weeks to months, at least.

And to provide things like aerial surveillance for air traffic. So that is another example of technology or capability that could be leveraged for range support, as well.

A couple of examples of onboard instrumentation for flight vehicles that are in the works, or being developed. Some of these could be, again, adapted or leveraged, potentially, for use on ranges.

Another example here, the UAV Battlelab at Eglin Air Force Base has done some extensive work to bring back video data from UAVs flying in operational scenarios.

And that is an example of some technology work that is going on to give an advantage to ranges in terms of being able to take advantage of data compression techniques to make more efficient use of frequency spectrum, more efficient ways to bring down higher data rates from test activities, particularly where some of those demands exist.

One last example is DOD's current interest in investment and developing this transformation of communication capability to provide what DOD has referred to as bandwidth on demand.

So another example of work that is going on, mainly, to provide operational needs but, again, that could potentially be leveraged to provide some new capabilities for ranges.

Okay. We put together some recommendations on what sorts of things might you want to do in the near term to try to move toward this new sort of capability for ranges in the future, primarily space-based, supplemented by mobile assets.

Have a whole variety of different things that you might go try to pursue. And one of the things, the one that I've highlighted in the box here, is the one I'm going to tell you a little bit more about.

We are currently working with some partners at the western range to put together a demonstration to show the utility of a UAV equipped with package on board that allows us to do, and demonstrate, the utility of wide band telemetry relay from a flight vehicle, through a UAV, down to the ground.

We put together a couple of the things that we referred to as sort of notional road maps within the fourth report in this study.

And the only reason I put this one in here is because one of the first things that we recommended that you do, on this development path for mobile range assets, is demonstrate the utility of UAVs for doing things like relaying telemetry.

So, again, that is what I'm going to tell you a little bit more about in this particular demo. So this demo consists of, really, two parts. The UAV portion with the wide band telemetry relay capability on board.

Lockheed Martin mission systems has developed this package that can fly aboard the UAV to do the telemetry relay. It receives launch vehicle or ballistic missile S-Band telemetry signal.

Also if the flight vehicle has video cameras on board, like some of the dramatic video you've seen during space launches we can take that data down, as well, through this package.

And then the second portion of the demo says we are building some -- Lockheed Martin, actually, is building and installing some ground equipment to do some processing and display of the telemetry data, and compare the data in terms of its quality and completeness, etcetera, to what the western range collects through the usual systems.

So here is the cartoon illustration. This particular demo uses a Perseus-B UAV to fly the small package on board. This vehicle has an endurance of about eight hours, and it can fly up to altitudes of about 65,000 feet.

So this thing can stay out there well in advance of when the launch goes up. It only flies at about 65 knots, so it takes a long time for it to get to any place where it is not supposed to be.

So I guess I call that a safety advantage of a vehicle like this, is that it moves pretty slowly. And, again the idea here is that it takes down the S-Band telemetry, brings it down on a Ku-band signal to a ground station, and then will bring it over for processing and display in a room in the western range ops control center, where the ground equipment will be set up.

The schedule has actually changed since I put this chart together. We are planning to do the demonstration, to fly the UAV, as an associated op with either a ballistic missile test launch, or an Atlas launch in June.

So this has moved up a couple of months. The launch schedule, as everybody knows, is fairly fluid at times. And so trying to get everything to match up with a launch on the schedule has led us to try to do the demo.

One of the other technologies that may end up being demonstrated on this UAV flight is this vehicle-based independent tracking system. And this is a package that has been developed by Space Information Labs out in California.

It consists of a GPS receiver, its own internal power supply, and the capability to process and integrate the GPS receiver data with the vehicle telemetry stream, and bring it down, through a Globaltar modem, in a format that is recognized by range safety.

So this is, I think, a very interesting capability. The whole hardware package, including the antennas, the cabling, and the power supply, weigh about 25 pounds. So it is a small package that you can put on board a small vehicle like this UAV.

Obviously, also, potentially adaptable for use on other flight vehicles, aircraft, for testing at Edwards for instance, or potentially even launch vehicles.

So the key goals for this demo are to actually prove the concept of using a UAV as a mobile range platform to bring down the telemetry from a flight vehicle, in real time.

Also the potential to bring down the video stream at the same time, so it is a wide band link, if the video is available on the vehicle that we fly it against, as an associated op.

And then the ground-based portion to actually record and display the telemetry data in the range ops control center.

One other aspect of the display capability is that it uses commercial off-the-shelf software to provide a 3-D graphic representation of the vehicle orientation and position, and superimposed is a cone of the acceptable flight corridor.

So it is a different way of approaching range safety capability in terms of what the displays would look like.

We have been interacting with the

stakeholder community, the range stakeholder community, again. Some of you have probably seen an in-depth version of this briefing. And we have gone through how this potential advantages of these UAV could play into these categories that we listed as the desirable attributes of a future range capability.

So I appreciate those of you I have talked to, before, who have given us inputs on how you think we can set up measures of effectiveness, measures of performance, to illustrate how this UAV demo contributes to this path forward that we see, that we think make sense.

And there are several others of you here who I see, who probably also have some great ideas on how this thing might be of utility. So if you do have ideas like that, I would be very happy to take your inputs on that, as well.

Because what we are doing is putting together a test plan that lists the measures of effectiveness, measures of performance. And then when we actually conduct a demo we will be collecting the data, and then reporting on it, again, to the range stakeholder community.

Here is the list of organizations that we either have, or plan, to talk with about the demo. And the next steps, as I just mentioned, include actually conducting the demo in a few months, and collecting and analyzing the performance data, putting on an evaluation report, and hopefully reporting on a successful demonstration, and a great illustration of how we might be able to move forward toward expanded range capability for the future.

Thanks again for the opportunity to be here today, I appreciate it very much.

(Applause.)

MR. COOK: Thank you, Vic. And now I will ask Darren to come up and put all this information into a larger context, so that we can create a vector. Thanks.

MR. SKELLY: I have to say that wasn't, I guess, something I would choose, following Vic. Vic always does such an outstanding job identifying the future, and the project that he has been working on for the last couple of years.

So outstanding, and as well, there has been some very good briefings this morning. I'm very enlightened, and encouraged by Dianne’s comments this morning of the Air Force's goal to reduce the cost of ground assets, and their desire to go to space-centric type systems.

I think that is very vital to our development of the space industry. And, also, Commissioner Walker, as far as his Aerospace Commission report, speaking this morning, I thought that was very interesting as well.

He validated some of the thoughts that we are working on with a need for heavy investment in R&D in the air traffic, or the spaceport and range type technologies.

And, also, his desire for interagency cooperation is something that I think is key, if we are ever going to really turn the corner on technology improvement.

Well, good morning. I'm Darren Skelly from NASA Kennedy. And thank you very much, Hugh, and Patti stepped out, but thank you for the opportunity to talk with you this morning about some strategic planning, and some road mapping efforts trying to lead for the nation.

I like to use this picture when we go out and talk about what we are doing, because it gives a very good grounding of some of the activities we do at NASA Kennedy.

And you can see some pictures there, imbedded, of expendable launch vehicles program. You can see the shuttle landing in the middle of the picture; you can see the completed space station.

But it is also patriotic, and you can see the flag and the eagle. But it is also visionary. You can see some galaxies, and some pictures from Hubble.

But also on the lower right-hand corner you can see exploration, and human exploration at one of our nearby earth planets, Mars. And that is something I would like to take as our next step with NASA.

Of course I can't speak on behalf of our agency. But it is one of my visions to be able to see people walking on that planet. And as my 8 year old son always tells me, he wants to be the first marine biologist on Mars.

And I think through discussions such as today, and through some of the working groups forums that I'm going to talk to you about, I think we can help to realize, and get to these dreams.

NASA Kennedy is primarily known to most people in the industry as where all the smoke and the loud noises come from, our launch operations. But we also are research and development center, and spaceport and range technologies.

Two key areas of enabling technologies to hopefully open the commercial industry. If we are ever going to see business evolve, as we all want it to, where we have doorstep to destination type travel, turnarounds on vehicles in a matter of hours versus weeks or months that it takes now.

And the opportunity to have spaceports in across the nation and, eventually, around the globe. We need to have a long range vision. And that vision has to include research and development, spaceport and range technologies.

So to give you a little background on the working groups, in 1999 the President appointed the OSTP and NSC to put together and co-chair an interagency working group to look at the current state of our space launch industry.

And they came out with six primary findings, and the sixth was the most important to us at NASA. And that identified a need for identifying next generation technology development in spaceport and range technologies.

Of course we hear a lot of these motherhood words all the time to improve safety, flexibility, capacity, and to lower costs. They suggested that NASA and the Air Force get together to hold together a national coalition, and a national forum, where we could identify the road maps for the future.

NASA identified Kennedy Space Center as the lead organization to help co-chair that, and the Air Force identified Space Command.

A little over a year ago we put the MOU in place to form this group up, and then the ARTWG was established. And, as I mentioned, it is co-chaired on a NASA Kennedy and Air Force Space Command.

Along that same time frame, and as you saw on that last chart, we have a mission at NASA Kennedy to also be a spaceport technology center. So we developed the advanced spaceport technologies working group, along the same time frame.

That is chaired by NASA KSC, and Ms. Cris Guidi is in the audience with us today. And it has a vice-chair of Tim Huddleston of the Coalition of Spaceport States.

If you look at the macro space transportation system, and this is the way that we broke down the node, traditionally the investment, and the focus, and the targeting, and improvements, have been in the blue areas, the payload, the vehicle, the mission, and flight control.

And there is a significant need, as far as propulsion systems, structure systems, thermal systems, etcetera. But, traditionally, spaceport and range technologies have not had sustained, or significant investment, or significant focus on how those technologies need to evolve over time.

And we hear a lot of presidential, or commissioned reports coming out with these targeting improvement opportunities. Just in this November the Walker report said that we should reduce cost by 50 percent, and reduce turnaround time to be more in line with the commercial airline industry.

And if you look at the current pyramid of looking at just our reusable launch vehicle right now, the only one we have operational, the shuttle; the amount of ground time, and you could replace ground time with cost, or you can replace that with touch labor.

If you look at the pyramid now it is very much focused on a lot of ground time for a very minimal amount of flight time. And what everyone wants to do, and what these reports keep saying is we need to invert that pyramid.

We need to open up markets, and we need to open up the opportunities to go to a lot of flight time with very minimal cost, very little ground time, whatever it is.

So focus technology improvement across the whole macro space transportation system is going to be the way that we get there.

Next chart, please. We affectionately refer to this chart as our octopus chart. I don't know why, it just kind of looks like a bunch of tentacles.

But what it really tries to represent is that the advanced range technologies working group, and the advanced spaceport technologies working group, has a coalition across the nation.

In the advanced range technologies working group we have approximately 250 members. And in the advanced spaceport technologies working group it is 100 to 150 type members.

So we are very big consortium. And it is made up of spaceport states, it is made up of other military and DOD organizations. We have seven Air Force centers represented. We have Department of Commerce, Department of Transportation. Of course the FAA is a significant partner with us.

It includes small business, there is 51 aerospace organizations in participation. And, of course, the traditional big launch vehicle providers, such as Orbital, Boeing, Lockheed Martin.

We have all 10 NASA centers represented and participating. And, of course, Kennedy Space Center.

Next chart, please. This is similar to the last chart, but it just kind of tries to represent it a little bit differently. That if you look on the left-hand side, what we are really trying to do is identify common technology needs that are beneficial to all, regardless of what your mission is, if it is space launch access, if it is defense access, or defense posture, or whatever, or emerging spaceport states.

You see that we are trying to identify road maps and technology needs for spaceport and range technologies. Around the middle picture you can see the various themes, and the way that we have broken down the problem.

And what we are doing, on those various themes around spaceport and range technologies, those are the things that we are road mapping. And what we are trying to make sure that we pay attention to, as you see across the top, is the current programs, the current vehicles, the emerging vehicles, and where the future is going.

So we are trying to make sure that we are taking everyone's needs into account. And along the bottom you can see all the various governmental agencies.

And as the Commissioner Walker said this morning, interagency cooperation is a key to moving forward. So I was very enlightened and optimistic that he was saying that.

And we didn't mean to not give it as significant sponsorship, but it became too large. But we have a final block on the bottom, down there, called non-government.

And this is the states, the coalition, it is the commercial industry, it is academia, etcetera, those are all represented in that one block.

And, again, our goal is to meet national benefits to goal, as far as operational efficiencies, economic efficiencies, national and global security, and improved quality of life, the doorstep to destination type travel.

Next chart, please. These are not breakthrough thoughts, and Vic was reporting on his study, that he has been doing over the last year and a half or so. And this is, actually, complimentary to a lot of the things that he was talking about.

If we look outside the box, and we try and look 20 years, 25 years in the future, and over the last year and a half, as we got together and met, and we've had this coalition together, we are starting to see through the smoke and the fog a little bit, and identify some of the near term, mid term, and long term visions that we are trying to evolve to.

And we heard some of the discussion of some of the examples of those technologies that we are hearing right now, so it kind of validates some of our thinking.

In the near term we want additional demonstrations with space-base based constellations. Of course the first step is GPS. But what is the next lower orbit system? Is it TDRSS, or is there a next evolution that we need to get to?

Additional demonstrations, and Vic mentioned a good demonstration that he is talking about with UAVs and other mobile and deployable assets, improved modeling and data base systems, knowledge based systems with data mining techniques.

And then one significant theme that we are hearing over, and over again, is the need for interoperability and standardization on an individual range, or an individual spaceport.

Systems that know how to -- that are interoperable, and know how to communicate, and standardization of those systems is the key to moving ahead in the future.

In the mid term we see, again, additional use of demos and space-based assets. And moving from demonstration of space-based assets into further implementation of space-based assets, and further implementation of mobile and deployable assets.

We see the evaluation of the, of course, the knowledge systems and the intelligence systems, and data base architectures. Demonstration, additional demonstration with on-board autonomy.

People start getting nervous when you start talking on-board autonomy. So we are seeing it as let's take the baby steps and do some demonstrations first, and prove out the technologies.

And then the final bullet on the bottom, the middle column there, is that improved interoperability of systems throughout a network of ranges.

So move the interoperability from just among a single range to interoperability among a network of ranges.

Long term is in line with everyone else's comments, is that we see a space centric solution with 80 to 90 percent of systems being space based, and mobile and deployable assets augmenting that, with minimal ground-based structures at the local launch or departure site.

We see implementation of autonomous systems, and I made sure that we put as-desired.

Because in some military organizations, I don't know if we are ever going to get to the completely autonomous systems.

Improved data base systems. And then the final step of the interoperability is to go to a national and a global interoperability of systems.

Next chart, please. As far as our process for working the advanced spaceport, and advanced range technologies working group, we have a very robust process, and this tries to identify that for you.

And this is primarily focused just on the advanced range technologies working group, but a similar process is being used for the spaceport technologies working group.

Where we go through the systems definition, the performance gaps, the technology gaps, and then the technology development flow. The systems definition, which includes the range system definition, and the range stakeholders needs of tomorrow, that is really where we try to look in the crystal ball.

And then we identify what is today's range system and how does it operate, and what are the future of space system needs. What we did is we broke that down so that we could get the first words to paper by a vision team.

And we got a smaller subset overall, a bigger organization together to try and put the first words on paper so that we at least get a product going. And then that product was then sent out to the bigger membership for review and comment.

Where we are right now is in the technology gap assessment. And we are looking at where we are in today's technologies and our future technologies. And we are at the individual thrust area, road map development, identifying the technology road maps.

Now, the eventual goal is that, hopefully, all these stakeholders that do have dollars that they can bring to the table, and looking at the high level assessment, and then define resource allocation, is that by working in a national forum such as this, those that do have dollars that they can bring to the table, can help when they get out the other end of the door, and we have these road maps developed, will help to develop and sponsor these technology projects.

And what this will do, it will allow us to integrate our efforts so that one agency won't be developing technology that another agency will be also interested in.

And where there is opportunity, where we can bring dollars together, to go help collaborate and develop the technology.

Next chart. I'm not going to speak real long on this chart, but what it shows you is this is the way that we've broken down the advanced spaceport technologies working group.

We are identifying improvement opportunities and/or road maps for these areas. And I say that because what you see in the first square is the visions and the architectures. We are not necessarily road mapping vision and architecture, that is just a work breakdown structure of our functional structure of how we are operating.

But under the spaceport functional thrust areas you can see the seven technology areas that we are identifying road maps in advanced spaceport technologies.

But there is also the softer sciences, and we can't ignore those. And those are very important if we are going to ever improve and implement these technologies. And that is commerce development, education outreach, safety, and environmental.

There has to be incremental and significant improvements in each of these areas as well, as we also identify the technology road maps below.

And you can see the one that is dashed

around in red, that is the traffic and flight control operations of a spaceport. And that technology effort is being done in the advanced range technologies working group.

What we've tried to show here, again, is that we've broken down the advanced range, or range system into subsystems. We try to show it as a system type architecture, or communication architectures and technologies are really crosscutting across tracking and surveillance, telemetry and weather.

And then they support a decisionmaking technologies which eventually in the real world would go to the launch decision. Scheduling and coordination of assets, as you see along the right hand side, is cross cutting across all those.

So all those technologies affect all those other areas. What I also show on here is our leadership team. And what I try to do, when we pull together our leadership team, is make sure we have strong technical people in each of these areas.

And what we have is co-chairs in each of these areas. But we wanted to make sure that they had different perspectives, so that we wouldn't get solutions that were satisfying just to one sure.

Again, these are national road maps, they are for the benefit of all of us. So as we go through this, if you look at communication architecture, Maj. Scott Van Sant, out of Space Command in Colorado Springs, has paired up with one of our researchers at NASA Kennedy.

And tracking and surveillance is affectionately know Rembo, it is Rembert Schofield out of Florida Air National Guard. And he is co-chairing with Vic, and it is our privilege to have Vic help co-chair that session, or that subgroup.

And telemetry it is one of our ELV program leads, with Dr. Slavinski, out of AFRL. Weather it is John Madura, who is leading one of the leading edge research and development areas in weather technologies, with Rich Heuwinkel out of FAA.

Decisionmaking is, again, a modeler, and an expert modeler down at NASA Kennedy, with Marti Fallon out of Aerospace Corporation. Range Command and Control is Steve Switchkow, which is Command Engineer from the Shuttle program, with Dr. Phister out of AFRL out of Rome, New York.

And then scheduling and coordination of assets is Maj. Buck, who is also on the COMSTAC, working with Marti Waldman out of the 30th Space Wing.

So we do have a lot of government

organizations, but we also have some key industry and consultants included as well.

Next chart. I apologize for this chart. It looks good on paper, and I think the version on your handouts might be legible, but I know it is probably an eye chart in the back of the room.

What we tried to do is roll up our schedules for both the advanced spaceport technologies working group, and the advanced range technologies working group, into one schedule.

The first thing, though, in the middle you can see the conference, and it says September. We've had three conferences to date. Our last conference was in Colorado Springs. We had approximately 150 members there, and it was sponsored by the Air Force Space Command, we had a very good turnout.

If you look across the schedule on the top, for the ASTWG, they are right now in their Tiger team efforts to develop some of their vision documents. And you can see that they have a series of telecons with the whole collective vision team to try and get some of the product together, and you can see where they are across the middle, where they are developing some of their vision documentation.

In March time frame they are going to have several multi-day retreats, getting together over a couple of days to try and, again, get the first level product out, so then you can send it out to the bigger collective community to digest.

We have also picked up, or will be picking up, technology gap consultant, RTI, will then take some of those initial products and then go out to industry and do some of the additional gap analysis that we need to make sure that we have our arms around where the current technologies are, and making sure we understand where we need to go in the future.

And, again, those products will go out to the general national community to get a review. Going across, again, to the middle you can see our next conference is tentatively planned in May.

That is going to be either in Orlando or Cocoa Beach. We are still trying to finalize some of the details. But the hope is, through the advanced spaceport technologies working group, that we will have some draft road maps that we can show.

And you can see the star in June for the ASTWG, is that their plan is to have the road maps together by June, but hopefully we will have some road maps to share at the conference in May.

For the ARTWG, coming out of this last

conference in Colorado Springs, even though we had been meeting in each of these focus areas on a biweekly basis, we identified the need that we needed to ratchet up a little bit more.

And so what we did is we did one to two days retreats in each of these technology areas. And you can see that we have been through command and control, tracking and surveillance, weather systems, telemetry, decision making.

We are going to have communication architectures retreat at the end of this week, and then scheduling a coordination of assets the next week, out of Vandenberg.

So we have had one to two day retreats in each of these focus areas, and we have draft road maps that we are pulling together, and doing the final polishing on.

And We've also picked up consultant services, courtesy of California Space Authority. They thought our initiative was so important they tossed some dollars our way, and we were able to pick up Booz, Allen, Hamilton, to help us make sure, again, that we are getting a good product, and make sure that we are getting good gap assessment, and technology gap assessment with what is going on with the industry.

And I can be pretty sure that we are going to have our road maps ready to roll out in the May time frame. So we are looking for this next conference as the opportunity to roll out the road maps and have many people do their final review and assessment on those.

So in closing, what we are really trying to do, is we are trying to build a community of people that have common technology needs, we are trying to map and develop the next generation spaceport and range technologies road maps.

I put our contact information and our webpage information on this chart. So thank you very much.

(Applause.)

MR. COOK: Let's entertain a few questions but keep in mind you are cutting into the break time, I believe. So questions, please?

Thank you very much. Vic?

MR. VILLHARD: I just want to mention one thing. Darren mentioned the role of the California Space Authority in sponsoring some of the ARTWG work.

Obviously you saw the CSA logo on the charts that I had up there, as well. And I wanted to mention, again, that California Space Authority has taken a dramatic leadership role in this whole area of improving range technologies and capabilities, and they have really been a visionary leader.

And I would encourage the other states to take a lesson from that, and maybe show some of the same kind of leadership and success that CSA has shown in pulling this sort of thing together.

MR. SKELLY: I would like to double Vic's comments on that. Thanks, Vic.

MR. COOK: Tom?

MR. FERRELL: It is maybe more of a comment than a question. And maybe also directed at Hugh, as the AST representative at the table up there.

We heard an awful lot of things going on, obviously a lot of good things. What I was looking for, and I didn't hear, I guess, particularly with your lead-in, Hugh, on the work that the SATNAV group is doing and ADS-B, is how some of the long lead items with these technologies are actually being worked within ARTWG, within ASTWG, within all of these different communities that are trying to pull the stakeholders together.

And I would like to give just one example. Prior to getting into business on my own, I worked for Iridium. And we needed to work through RTCA and ICAO for MOPS and SARs, items that Mr. Salvano mentioned.

These are not short-term propositions. You know, we had a plan that took us between 48 and 60 months to get the basic standards in place, to allow for common avionics.

And I think ADS-B was presented at the May COMSTAC meeting last year. We are now, what, seven, eight, nine months after that. We have technical issues that have to be solved to allow ADS-B to be of any use for the space community.

Just one example, having enough bits to represent the speeds at which our vehicles fly. What is being done by any of the folks on this table, or the FAA AST, to start turning the crank on these long lead items to make sure we are not just paying lip service to integrating stakeholders needs, we are putting the technical infrastructure in place to ensure they are truly integrated when we need them.

MR. COOK: I'm going to let the question just hang in the air, because it is the essence of the panel. It is a challenge, and myself and my people think about it all the time.

We note, for example, that most ADS-B hardware is hardwired to report altitudes to something like 102,334 feet. There is a physical hardware limitation on the altitude that may be reported within that particular chip set printed circuit board stuff.

So we know that, we are looking at that, we don't like that, we are going to find, we are going to have to keep that on the list of issues that we address, as we move forward.

Your point on certification standards, the documentation thereof, the long lead nature of that, the difficult nature of getting international and multiorganization cooperation and consensus on standards, in the context of turf, and legacy, and heritage, these are challenges.

I don't have an answer, a quick easy answer. But I will say that the composition of my panel is an indication of our awareness of the problem.

(Off mike comment.)

MR. SALVANO: I would like to add something, if I could. As I mentioned, I was up in ICAO Monday. And part of the planning is there is a critical meeting, this 11th Air Navigation Committee Meeting coming up the end of September, first week in October.

The last one was held in 1991. So they don't happen very often. But one of the things that we were discussing with the U.S. mission up there, is from a United States perspective, what do the United States want to achieve at this ANC meeting?

And we talked about, from my perspective now, looking at the NAS, we see the challenges of unoccupied aerial vehicles, UAVs. So we are going to have slow high, and slow low UAVs in the system at some time in the future.

How do we, from a NAS perspective, and then looking at a seamless air transportation system, the ICAO goal, develop SARPs. The other piece of it, we are going to have aerospace vehicles in the NAS at some future date, both occupied and non-occupied.

How do we integrate that, how do we develop that? Is that something, from a U.S. position, that we want to start the work now at ICAO.

We are going to have technical sessions at ICAO in both ATM and CNS, and we are going to have plenary sessions. And the process that we go through, on the FAA lead for the ANC.

So part of that is we had an outreach session to the aviation community, of trying to see what issues do we want to bring to ICAO. Because the Air Navigation Bureau is typically 5 to 7 years to finally approve SARPs, from its inception, to final approval by the council.

So that is the type of window you are looking at. Luckily, within RTCA, for a change, our internal bureaucracy is a lot less.

MR. FERRELL: Just very quickly, having been one before, on multiple occasions, a private sector advisor to the FAA at ICAO panel meetings, I would hope that AST will consider having, first of all, a presence of their personnel at that meeting, but also consider having some of the folks in this room serve as public sector advisors to that meeting.

So that we really can address some of the technical infrastructure details that are the long lead items this industry will depend on.

MR. SCANDURA: Phil Scandura, Honeywell. I just wanted to follow-up on a point that Tom was making.

We, in industry, have to deal with the standards or lack of standards, depending on what you are looking at, and there was a perfect example, in this morning's presentation, of GPS technologies that were used in an aircraft that won't work in launch vehicles.

Now we are talking ADS-B technologies that work well in aircraft, but won't work on launch vehicles. So we are developing things, on the commercial side in the FAA that are great for the national airspace, but won't work in the space arena that we are trying to integrate.

So from an industry standpoint, at Honeywell will build thousands of GPS systems because they can put them on thousands of aircraft. But when you are talking four launch vehicles, it is kind of hard to justify all the changes that you need to make for four launch vehicles.

So if we don't get the standards figured out now, to where we can take our commercial products and leverage them onto space, you are going to get cheap GPS, and you are not going to get cheap ADS-B, if the business case is there.

DR. SAKAGUCHI: Let me respond a bit to that. I hear you, I would love to see standardization.

Let me tell you what is going on with EELV. We managed to get the two EELV contractors, Boeing and Lockheed Martin actually working together. They have been having a whole series of meetings, and they are working on the development of what GPS will look like on EELVs.

Now, since it is only the two contractors involved, you would think that probably we would come up with a standard. But DOD doesn't want to dictate that standard, we don't want to say, okay here is exactly what the on-board system should look like.

Well, right now we think they are not going to manage it. They are doing a marvelous job of working together, but Boeing and Lockheed Martin have very, very different visions for what the GPS is going to look like on-board.

They are still going to try to come up with a common standard, and we are going to let the two contractors develop the standard, if they can come to an agreement.

But if Boeing and Lock-Mart can't come to a philosophical agreement on what this should look like, and it is really a philosophical difference at this point, then we at DOD are not going to say, okay guys, neither one of you are right, or this guy is right, you must do what DOD wants.

We are going to let the contractors make their own decision on what works for their vehicles, their technologies. I don't see any other way to work it.

MR. SALVANO: Well, let me say something, because I'm going to put my program office in a little bit of a bind. One of the reasons why we in civil aviation went to the WAAS, wide-area augmentation system, WAAS.

GPS is a great system but -- in navigation not only do we need accuracy, we need availability, continuity of service, and integrity. GPS, as it exists today, does not meet those requirements.

And I would think, in commercial launch you would need availability, you need continuity, definitely, depending on how you define continuity of service, and you need integrity.

For the WAAS program we control the specifications. We have similar issues with acquisition of GPS, which is one of the reasons why we have two GEO satellites, which the FAA leases today.

We are about ready to go issue a contract award for a third GEO satellite, for the acquisition and tracking issues from vanilla GPS. You may want to look at -- assuming GPS is there in some way, shape, or form, depending on the DOD budget, as they modernize, is there a way you can either supplement for your own uses, or tack on to what civil aviation is doing?

I don't know the realities of your needs, but at some point in time you should really look at what we are doing, in WAAS, and say does that work for you? Or maybe even local area, which is our precision approach requirements, with satellites.

But we are creating a system, and to me whether we have the national air space system, or we have the national aerospace system of the future, we need to work, and that is part of the interagency cooperation, in working with our customers.

MR. SCANDURA: And that is the important point, I think, that we are trying to make on this side of the audience.

Regardless of its GPS, ADS-B, WAAS, whatever, the point is we are talking about future where air and space vehicles share the same space, share the same infrastructure, and in many cases share the same equipment.

And without interagency coordination, without standardization, the long lead time that Tom talked about, we are going to go off building equipment that meets FAA needs for civil, but not FAA needs for space, or DOD needs for space, or whatever.

And you are not going to get the efficiencies, you are not going to get the interoperability, you are not going to get off-the-shelf equipment.

What we are doing in FAA land is great, but it focuses on a very specific audience, civil. Trying to ride on the coattails of that won't work. Having space ride on the coattails of that won't work, if we don't take into account the space needs, and vice versa.

It was interesting, on the GPS presentation, it was the first time that I heard that commercial GPS won't work on a space vehicle. I haven't been following but, you know, it just surprised me.

So, again, from the industry side, we need to coordinate all these things so that we can take advantage of scale, and economics.

MR. COOK: An 89 dollar Boater's World hand-held GPS won't work on space vehicles. GPS will work on space vehicles.

MR. SCANDURA: But will a commercial aircraft, a GPS box you get a --

MR. COOK: But you are taking the limitations way beyond the scope of this. I just wanted to refute. There is no fundamental problem with GPS in general, there are some issues with high velocity doppler, and issues with filtration due to -- there are issues, but they are not insurmountable issues, there is nothing fundamentally wrong.

DR. SAKAGUCHI: I didn't mean to say GPS receivers will not work on launch vehicles. It is just that the launch vehicle contractors, and AFRL, and some other places, have been surveying all the available GPS receivers, and there is none that meets all the requirements at the moment.

Some are relatively minor things which can be changed easily. A minor one is that at the moment range safety requires a certain update rate, and there is almost no commercial receivers that meet the update rate.

Now, maybe we can go back and tell range safety they have to change their rate. But right now we are taking that as a given, and that eliminates an awful lot of the receivers on the markets.

Most of the other problem has to do with the software in the receiver. Again, it is fixable. I did not mean to imply that it wasn't, it is just that in all the organizations that We've talked to, when they've gone through a search, none of the off-the-shelf receivers meet all the various requirements, including the ones for high dynamics.

(Off mike comment.)

MR. COOK: We are really into the break now, but maybe we will take one more.

(Off mike question.)

PARTICIPANT: Hot plasma may not transmit the GPS signal. In fact, shuttle communications are lost during reentry, during launch you could have a similar problem of communications blackout.

And, in fact, whenever we have a solar storm, a magnetic storm, we lose GPS signals. And so the question would be to really demonstrate that launch conditions, hot plasma, instantaneous tracking and telemetry work well before we invest any more.

DR. SAKAGUCHI: There are a number of efforts under way that have already demonstrated a lot of GPS capabilities. But, you are right, we are not there yet. That is why I had challenges on my chart.

AFRL has done some GPS launch vehicle demonstrations out of Kodiak. The Orbital folks have been flying GPS with funding from DOD, on launch vehicles for a while.

We've got some pretty good flights from them. We do know a lot of the plasma effects. But one of the things that ground is doing is working to eliminate any single points of failure in the telemetry system, because we never, ever want to have to blow up a vehicle because we lost telemetry. You are right, there are still challenges ahead.

MR. COOK: Okay. With that, thank you very much. I appreciate the passion of the questions, and we feel the same about the subject ourselves up here. Thank you.

MODERATOR MURRAY: We are going to be taking a ten minute break, and we will convene back at 11:25 for our Panel on Space Education.

(Whereupon, the above-entitled matter went off the record at 11:15 a.m. and went back on the record at 11:33 a.m.)

MODERATOR MURRAY: We have a slight change to the agenda, so it is going to be a little tight for lunch, so we would like to go ahead and get started, so we can end at a reasonable time for lunch.

Our next panel is space education, and the panel is going to be moderated by Camilla McArthur. Camilla McArthur is a technical communications specialist with the AST licensing and safety division, and is responsible for editing and publishing AST directives.

She is also an FAA education program counselor, and a member of the AST educational outreach program. As a result she develops educational materials, and represents AST in a variety array of outreach activities.

Camilla has been with the FAA for a little over a year. Camilla?

MS. MCARTHUR: Thank you, Michelle. There has been a bit of a change in the format of the way we are going to do this particular panel, so I'm going to give you guys a brief overview.

We have been fortunate enough to add a speaker from -- and so we are going to adjust things a little bit. She is Misuzo Onuki from Japan, and she is going to give us an update on the status of commercial space activities in Japan.

She is a member of the Japanese Rocket Society, the Air and Space Transportation and Research Committee of the Japanese Aeronautical Association.

Ms. Onuki has a background that includes working for space systems division of the Shimizu Corporation for more than ten years. Shimizu proposed a space hotel in 1989, and since then she has been performing research and development efforts in space tourism.

She established the Japanese Women's Space Forum in 2001, and has completed a number of feasibility studies under the contract from the National Space Development Agency.

She is also working for the National Museum of Emerging Science and Innovations, as full time member of the Administrative Office, and Organizing Committee of the Planetary Congress of the Association of Space Explorers.

She has been kind enough to agree to give us this presentation, so we are going to incorporate that into the education panel. She will speak first, and then I will come back and introduce the remainder of the panel members, and then the panel will proceed in its normal fashion.

We are asking the attendees to reserve all questions until the end, so that each one of the speakers will be able to complete their presentations.

We don't plan to run over into the lunch activity but, in the event that the questions do run over, we will notify you at 12:30, and if you want to continue, we will go on, the panel has agreed to go on for approximately ten minutes after that.

Those who want to go ahead and leave for lunch because they have other commitments, or whatever, feel free to do so. And so the maximum that this particular briefing may run over would be about ten minutes.

But we felt that the information that she was bringing us was of such value that the attendees would enjoy hearing it. So let us begin with Ms. Misuzo Onuki.

MS. ONUKI: I will introduce space tourism studies in Japan, mainly Japanese Rocket Society's activities, and the Japan Aeronautical Association's activities, and some projects toward commercial space activities for the general public.

Japanese Rocket Society, JRS, established several research committees on space tourism under the coordination of the JRS' academic committee headed by Professor Makoto Nagatomo and his colleagues at the Institute of Space and Astronautical Science, ISAS, in April 1993.

It is tenth memorial this year and we are planning to have a memorial conference on 8th May.

Since 1993 four committees had been done; one is Transportation Committee in which technical feasibility, Reference Vehicle Design, flight worthiness was studied from 1994 to 1998. Based on the space tourism market research which had been done in Japan several times.

The concept of the KanKoh-maru passenger carrier vehicle was established in this committee. Kankoh-maru is a single-stage-to-orbit (SSTO) vehicle capable of carrying 50 passengers on board to and from low Earth orbit.

Second one is Enterprising Committee, in which business feasibility study was done from 1996 to 1998. Third one is Regulatory Committee, legal aspects of public space traffic was studied in 1999.

The first one is space tourism research forum in which operator's requirements, public acceptance were discussed from 2000 to 2002. And, also, the Space Tourism Research Forum worked out a basic specification for the first generation spaceships for tourism.

The uniqueness of this specification is that it is the first specification composed by representatives of airline community in Japan by those who are involved in the development and production of space vehicles.

It is hoped that this will encourage dialogue between users and makers. The research task of the JRS' space tourism research forum was taken over by the Air and Space Transportation Research Committee within the Japan Aeronautic Association, JAA, which is the most influential aviation community in the industrial organization.

This take-over means that the Japanese airline community is interested in the realization of the space travel and now committed to their involvement in the space development campaign as a spokesman for spaceline entrepreneurs.

There are almost 50 members including more than 10 board members from space agencies, airline companies, space industries, insurance companies, travel agencies, and so on.

JAA committee is conducting a research

project on safety for manned space transportation system under the contract from National Space Laboratory, NAL. In this research a questionnaire for a pilot will be done next month.

Pilots must have many requirements for safety of a vehicle, from their experiences. Pilot's safety requirements will be a good reference for the design of manned space vehicle.

I also introduce some of commercial space activities in Japan. NASDA has been promoting culture, education, business, and industrial uses of Japanese Experimental Module, named *Kibo* to contribute to a better life on the Earth, through ISS utilization.

NASDA has conducted feasibility study, and pilot project, to promote ISS/KIBO utilization in various disciplines. Feasibility study is to evaluate feasibility of the theme.

Twelve themes, such as message delivery service, data archive service, space theater, space uniform, space robotics competition, space food, space gardening, space noodles, space art, education using video camera and so on.

I propose involving these three feasibility studies in space uniforms, space food, and space art as a total coordinator of Japan Women's Space Forum.

Pilot project is to verify realization of the theme as a business, two themes carried out for these two years. The first one is commercial film shooting, is to make commercial film using visual image data recorded by HDTV camera in ISS.

This was conducted by the biggest advertisement company, Dentsu, and sponsored by Otsuka food company.

And the other is message delivery service, which is called Star Mail by IHI Aerospace Corp. The Star Mail is personal message services from a star, ISS. Two kinds of services are prepared. One is Star anniversary service.

IA Corporation send a message to the International Space Station and stores them for a year, and send them from the ISS on the specified time, to the specified person via email.

The first message CD will be carried next April by Progress.

The second one is STARDIARY service. IA Corporation send a message to the ISS, store them for a year and make them a shooting star.

NASDA also promote industrial users such as biotechnology, PR-Branding, foods, cosmetics, nanotechnology, materials, environment preservation, and energy.

And last is also a topic of space tourism, Lunar Cruise project was started in April 2001. Its concept is not just for astronauts, for everyone. The final goal is to realize lunar trip which is open to the general public around 2015.

Lunar Cruise Project activities is not only engineering aspect, but also create space culture and so on. The first phase of this project was performed from the end of April to the end of May last year.

Lunar Cruise 2002 exhibition was organized so that ordinary people can feel space is actually accessible to them. The exhibition was conducted by a team in alliance with a variety of experts, such as researchers, engineers of space development, designers, artists, and economists.

And Dr. Kubota is also senior academic advisor of this project. The exhibition was very popular, especially to teenagers and twenties. It was a very good success.

I introduced Japanese topics both space tourism and commercial space activities. Thank you very much for this opportunity.

(Applause.)

MS. MCARTHUR: Thank you very much for

bringing us that information. I'm going to shorten my introduction just a bit regarding this education panel.

In 1976 the Airport and Airway Development Act of 1970 was amended via Public Law 94-353. Congress intended to place great emphasis on increasing the general public's knowledge of the dynamics of aviation and the key role aerospace transportation plays in improving economic and social life of all Americans, and to acquaint young people with the full potential of finding careers in the air transportation systems.

Many things have changed since 1976 but one thing remains the same. And that is the need to encourage young people to prepare themselves academically and to explore space related career opportunities.

In recognition of the importance of the ongoing need Associate Administrator Patti Smith has implemented the FAA Office of Commercial Space Transportation Educational Outreach Initiative.

The mission of this initiative is two-fold. First we want to stimulate interest and passion in the U.S. commercial space transportation industry, and related fields.

Second, we want to increase the talent pool for potential careers in transportation, and related fields. To that end AST staff members have supported a number of educational outreach efforts.

Examples include giving presentations to students at area schools, staffing exhibit booths at public events, and supporting the FAA Centennial of Flight Program.

We've also facilitated introductions between representatives at Parkview Elementary School here in Washington, D.C., and Tosuda Elementary School in Japan. This introduction resulted in an international communications exchange project for these students that, in many ways, is similar to a pen pal relationship via the internet.

Such interactions allow young people to broaden their understanding of people and cultures from other parts of the global village in which they live, and to discuss a variety of topics, including math, science, and language arts.

Such a project would not have been possible, given the state of technology, in 1976. Even now such opportunities for students would be impossible without visionary educators, such as Dr. Barry Sprague of Parkview Elementary School, Mr. Akio Watwsuki, principal of Tosuda Elementary School in Matsu City, Japan, and professor Hirotoshi Kubota from the

Department of Aeronautics and Astronautics at the University of Tokyo.

Unfortunately neither Dr. Sprague, nor Mr. Watsuki, could join us today, but we are fortunate to have with us Professor Kubota, and he has been kind enough to serve as a panelist on this particular session.

We initially had planned to have Sheila Bauer, and you will notice that her bio is in your notebooks, but she became ill at the last minute and will not be able to join us, and he was kind enough to step up to the plate and become a panelist for this session.

We also have, from the National Aeronautics and Space Administration, Mr. Edwin Prior, and he is the Director of the Office of Education at NASA Langley.

You know we have our member of longstanding, Mr. James Pagliasotti from JMP Associates. He advises clients in strategic planning for business development, government relations, education, and outreach, with an emphasis on high technology industries, and is a founding member, and former executive director of the government relations for Aerospace Associations. His principal work was to develop ASA.

In addition we have been joined by Dr. Al Koller. He is from the -- he is the executive director of the Aerospace Programs at Brevard Community College. He is also principal investigator for SpaceTEC, the National Space Science Foundation Center for Excellence, for Aerospace Technical Education.

And with that we will begin our panel. Again, we are going to reserve all questions until the end. And at that point in time, if you have questions for Ms. Onuki, you can include those with others for the panelists. Just identify the person that you would like to respond to your question. Thank you.

DR. KUBOTA: Thank you for the introduction, and good morning. I am Hirotoshi Kubota, and work in the Department of Aeronautics and Astronautics of the University of Tokyo.

This time I have two missions, so one is, of course, attendance in this conference. And the second is Camilla introduced me as a we have some exchange program, communication program at elementary school.

So it is an occasion, an opportunity, Dr. Patricia Smith came to Japan last year, May of last year, and we had a symposium of International Space Technology and Science in Matsui city, that is a local city of Japan.

And as a principal of elementary school in Matsui City, would like to have communication with U.S. elementary school. So I asked to Dr. Patricia Smith to have some opportunities of communication between elemental schools of United States and Japan.

So right now that is starting. So this time I went to Parkview Elementary school on the 10th of February, and I met with many students, many children of Parkview Elementary school.

So I am very happy to have such an opportunity of communication with younger generation of elementary school. I think I believe that such a younger generation communication becomes, is a space education in future. So I thank you much, I thank Patricia to have such opportunity to give us such opportunities.

And second topic this time is University Satellite Consortium. I put such a seat on a table in front of that room, with UNISEC, means University Satellite Consortium in Japan, and Space Education in Japan .

So this presentation by my colleague, Professor Nakasura, he also works in the University of Tokyo, and he presented in an IAF conference last year. So I introduce this presentation here, briefly.

In Japan we have student-managed nano-satellite project, at first in University of Tokyo from 1999 to 2002. It means, it is a nano-satellite, micro and nano-satellite means that CANSAT, some very small satellite.

And also in 1999 that CANSAT in 2000, and CubeSat is also nano-satellite. Then in the future there is the CubeSat launched into space.

University microsat project is providing best material for space education. Also offering a new way of space development, bridging between space community and general public.

So University consortium to space and development committed to low cost using hundreds of small satellites, and providing large number of trial and errors, and education and training of human resources, and constraints of university less than one to two years for working students.

Stringent budget and weight, volume, power limit. So it is a novel configurations next, please. Small satellites for space education. We have three parts. One is whole cycle of space and development; second is importance in general education; the third is education in project management.

This is a diagram of Japanese recent

history of university small satellite activities from 1993 to the present, is a phase of development.

Next, please. So in 1993 to 2002 is a satellite design contest we had. So objectives are, motivate more university-level students to study space systems, and improve skill and knowledge, then fabricate and launch the excellent satellite design.

So this contest has two categories of idea and design, and the effect is piggybacked launch opportunity of H-IIA rocket of Japan. So important and given entry level teaming to University satellite process.

Next please. It is a number of submitted works for satellite contest, in 1999 27 entries, and 10 qualified. Next please.

This is from such a contest, several excellent idea was originated.

One is a whale ecology observation satellite by Chiba Institute of Technology, so piggyback launch by NASDA and H-IIA rocket in last year, 2002.

University Space System symposium initiated by Small Satellite Working Group in 1998, and format of the symposium is there, to be authorized by Small Satellite Working on this.

CanSat-ARLISS launch experiments were held in Japan and United States. Rockets are provided by AEROPAC, an amateur rocket group, and CanSat is released at a four kilometer altitude at the Nevada desert. And ARLISS 1991 is participated by the University of Tokyo, Tokyo Institute of Technology, and Arizona State, three CanSat by each university were launched.

And ARLISS 2000 is participated by University of Tokyo, Tokyo Institute of Technology, and Nihon University as well. And ARLISS 2001 is five universities from Japan and Lockheed Martin from United States.

Next, please. This is an example of CanSat is a 1999, is a really small CanSat.

Next please. Is 2000 CanSat is a CanSat delivered by a parachute.

CubeSat to be launched in the 2002 to 2003 Dnepr rocket. Next please. An outcome of CanSat CubeSat project is, one is technologies to make up, fabricate that satellite. And also the management, and also many lessons learned like that.

Next please. To do list. Technologies for space, and support from government and space company needed in future. So in 2001 they established a consortium of University Satellite Consortium, is abbreviation, UNISEC. And this is a committee for small satellite of universities, space organizations, and companies, and industries.

Next, please. Then is a mission and tasks of UNISEC, University and Space Engineering Consortium, the mission is support university project for micro- and nano-satellite launching. And tasks is currently in Japan, but in future, internationally.

Right now the funding by government is uncertain, other companies for NOP, non-profit organization activities. So it is a URS. Is this the last one? Yes, this is the last one.

Establish an international university committee to pursue, not in domestic, to international. So indication of frequency, and also low-cost clustered launch of our satellite, and collaboration in satellite development, and also joint mission, and ground station network, and in future international contest and competition.

Thank you very much, that is my talk, thank you very much.

(Applause.)

MS. MCARTHUR: Thank you, Dr. Kubota. And now we will hear from Edwin Prior.

MR. PRIOR: Thanks very much, Camilla. When we talk about space education we believe, at NASA, that you really have to go to a pipeline model.

You have to educate not only the adults, and not only the students in colleges and universities, but all the way down to elementary school, grade school, even kindergarten.

So we have a series of shows that we've developed, over the last six or seven years. I'm going to give you some excerpts from those shows to give you a feeling about them.

But first let me give you just a brief talk, and I will talk kind of fast, to try to get back on schedule. Go ahead.

We all know as a result of a lot of things over the last 20 years, space can be very dangerous, going up there, coming back. And children have found that out, as well.

Cyrus in my hometown. The NASA vision to improve life here, to extend life to there, we want to get people out there, and to find life beyond.

When I first heard those words I thought it was too simple of a vision, but actually I kind of like it now. The mission, based on those visions, we want to understand and protect the Earth, we want to explore the universe and search for life, and to inspire the next generation of explorers.

That is where education really comes in. To do that we want to motivate students, we want to provide educators with all kinds of tools. We have workshops at all the NASA centers, and we do this.

We want to try to improve the nation's sites of illiteracy, and we want to engage the public.

Each NASA center, really, has focused on a different approach when it comes to education. For example, my friends at Glenn, and Cleveland, Ohio, have developed some terrific exhibits, and simulators for educators and students to use, that are in museums all over the place.

My friends at Ames have focused on using the internet, they have all sorts of interesting webcasts that they've developed, educational webcasts.

At NASA Langley we focused on distance learning. We decided to try to take advantage of educational technologies, and we've developed a series of educational TV shows. And, as I said, I will give you some excerpts in just a second.

Our purpose, to create innovative, engaging content. We have a bunch of partnerships in place to help us do this, otherwise it would be very expensive, so we have a lot of collaborators.

We have professional educators working

closely with us to make sure that we stay consistent with learning. And we have actually done a number of shows, not only at NASA Langley, but at all sorts of NASA centers, every NASA center.

Here is an example. By coincidence, this flier announces our latest show, that actually was shown yesterday on PBS, and on NASA TV all across the nation.

And this one, really, is not something we do at NASA Langley, we are primarily aviation and Earth Science. This is live from the Aurora. So we worked with Goddard Space Center. In fact the website is a Goddard Space Center website.

We get customer feedback. That is probably the most important thing in our educational programs. We make sure the teachers that are using the material, and there are several hundred thousand across the nation, that are registered, that get the shows piped right into their classroom.

A lot of them like to use the videotape, so they just use it during the time of the school year when they are on that particular part of the curriculum. But those several hundred thousand teachers represent a total of something, like, 15 million kids, K-12, kids across the nation.

These are the distance learning shows.

Four of the five are really educational TV, and those are the ones I'm going to talk about.

NASA Live is really an interactive show that I'm not going to have time to talk about. The one on the top, Kids Science News Network, that is one minute shows, I'm going to give you an example of some of that in a minute.

The NASA "Why" Files are now called the NASA Sci Files, or the NASA Science Files. That series has won three Emmys so far, and has an audience of something on the order of five million. I will give you an example of that.

We've also started doing some of those in Spanish, and you will see an example of that. I think it is very, very important to do that. The NASA Connect show, middle, is really our flagship show. That has won a total of five Emmys.

And, incidentally, a former FAA administrator was on one of our shows in 1998. That show won the Parent's Choice Award, the International Film Festival Gold Medal. And for two years in a row was selected as the best distance learning program in the nation by the U.S. Distance Learning Association.

The one on the bottom is for adults. And I don't mean triple X rated, I mean adults, I mean high school age, community college, lifelong learners.

That show has won its first Emmy, we are very proud of that. And I will also give you a quick example of that, as well, in a minute.

I'm now going to show you those, but before I do, there is a website. Anyone that is interested in seeing these shows, thanks to the State of South Carolina, they have put many of our shows, you can get it through streaming video, if you go to that website.

I don't like the name of the website, knowitall.org, but that is the South Carolina website. It is very nice of that state to do this for us, and you can see many of our shows on that website.

Several times I'm going to yell stop, and I don't mean for you to stop doing anything, or you will see my arm go up, and it doesn't mean that I'm taking a pledge.

My friend Al in the back is going to be showing the video. I will have no control over the sound, or starting and stopping this.

The first thing you are going to see, before you do it, Al, the first thing you are going to see is the youngest show that we do, which is a cartoon show, really, for pre-kindergarten, kindergarten, first and second grade.

It is one of our Kids Science News network shows, and this is just to give you a feeling for it, and somewhere along the way I will yell stop, and raise my arm, don't be startled.

(Clip is shown.)

MR. PRIOR: That gave you an example, it was kind of cartoonish, but you can see what a kid may learn from that. He may learn why day and why night.

Now, the next one is an example of the Kids Science News Network, the Spanish version. By the way, just fits and starts, I'm not a videographer, so I'm the one that did some of this.

(Clip is shown.)

MR. PRIOR: This is the Mars Odyssey. She is mentioning that we discovered evidence of water, plenty of water. Sorry about the roll, it didn't roll on my TV.

Now I'm going to give you an example here of our Sci Files, I think, is coming up. This is the three Emmy award winning NASA Sci Files. It is focused on grades 3 through 5.

(Clip is shown.)

MR. PRIOR: Bianca was the co-chairman of the National Space Day, with John Glenn, the young lady you just saw there. She is going to be chairman of the next Space Day, so we are very proud of Bianca.

I keep volunteering my nephews and nieces for this show, but no one has accepted them yet. Slight dead period here, this was my fault. As I said, I'm not a videographer. We should go by that in a second. Maybe you need to go forward a little bit, Al. This is the canyon on Mars.

(Clip is shown.)

MR. PRIOR: It is called the Ares Mission.

(Clip continues.)

MR. PRIOR: You can stop right there. I won't say anything more. The rest of the excerpts I'm going to show you are two from NASA Connect, with a couple of celebrities that we are real proud of.

And then the last thing you will see is our Destination Tomorrow, the opening segment of it, that is the one for adults. And that just gives you sort of the full range of the shows that we have.

Al go ahead and show it, and just run it all the way through, it will be a couple of minutes.

(Clip shown.)

MR. PRIOR: I just watched him last night in my hotel room, tuxedo. He charges 15 million dollars a movie, and he did that for free, for us. Actually he did two shows for us, for free. It is amazing.

(Clip continues.)

MR. PRIOR: You will recognize our next guest, I'm sure.

(Clip continues.)

MR. PRIOR: Every one of our shows has a classroom component, like you saw there. We try hard to make sure that we have good role model kids, and as many are represented as we can get, being involved in things in that classroom.

(Clip continues.)

MR. PRIOR: Now, the last thing you will see will be the adult show, Destination Tomorrow, which is now seen, it has a potential audience of 150 million. It is shown in 650 cable channels across the country.

(Clip continues.)

MS. MCARTHUR: Thank you very much. Next we are going to have Al Koller, and he is from Brevard College, and he will tell you about SpaceTEC.

MR. KOLLER: Thank you, Camilla. Good day, everyone. I'm one of those Florida guys who has lost his voice, Patti. The good news is I will do my best. The better news is I will probably make it shorter than I otherwise would.

Could we have the first chart, please? Got a little technical difficulty there? Okay, don't move that one yet.

When I saw Patti this morning I told her I really appreciated hearing from Gil Klinger yesterday. I have been in the agency a long time, I was a 30-plus year NASA engineer and program manager, all at Kennedy.

I have been with the college about 11 years now. I took an early retirement to do the education piece, because it became clear to me that we would not go back to the moon in my working lifetime. But that the people in the classroom would be the ones who might carry the torch forward.

And I was inspired, yesterday, by Mr. Klinger's talk. I told Patti I hadn't heard a talk like that on space policy in maybe 35 years, when Werner Von Braun did one at the Marshall Space Flight Center.

And it brought to mind that the torch you carry is a very, very important torch indeed. And everybody in this room needs to be reminded, and we do that by talking to one another, that you are the people who provide the focus for this country, shaping the future of aerospace.

It is a little bit like the two guys digging a ditch in the church yard. You've heard that story, and one is a real workman, perfect ditch, working real hard. Another one working right beside him just as hard, but smiling and whistling.

And you ask him what they want to do, and one says I'm digging a ditch, and the other one says, I'm building a cathedral. And I would just remind you that among all those jobs you do, the launches, the satellite manufacture, the test and check-out, the studies and plans, those are the pieces, that you are shaping the future of our aerospace program, and you are the champions for space exploration.

Choose any one of those five that Dr. Launius talked about yesterday, any of those five goals is fine with me, but we are the people who advocate for this country, and for our own children.

So what I want to spend the next few minutes talking to you about is a program that was initiated about three years ago at the Kennedy Space Center, and has spread nationwide, that is founded in the present, as this is.

This is a picture of the Atlas 5 that launched last August. Rooted in the present, but aimed very much at the future, recognizing, as the Walker Commission recognized, that there is a shortage on the horizon of skilled technical workers in this world, and particularly in this country.

And that you and I maybe haven't done quite the job we could have to inspire our children to study math, science and technology. And as a result of that we have some work to do. And this was in an initiative begun with that in mind.

Next chart, please. The challenge, and I'm talking to the choir here, I'm not going to spend much time, you know the aging work force, you know the structural changes in the industry, and of course the societal changes that surround us.

And if you need any evidence of that we just saw it with Ed Prior's videos. Those wouldn't have sold very well 20 years ago, and they are the way you have to do it now.

The response maybe you don't know so much about. We have an aerospace technical education partnership, in fact a series of those, and I will talk about an example in Florida that will knock your socks off.

And if you heard anything in this conference, I hope you heard the partnerships that are emerging to do all kinds of things, and education is certainly one of them.

We have, in place two year college degree programs, both at the Associate, and at the Applied Associate degree. There is a national infrastructure that is in place and growing, and it needs your help.

And we are in the process of developing, for the first time, national skill standards for those competencies. This is the goal, it is pretty straightforward and simple, but not so easy to do. Create and deliver a program of study built on industry based performance standards for the aerospace technician.

The first time I told my local advisory committee that we were going to do that, they didn't believe me. I had to tell them about a dozen times that they owned the curriculum. Nobody in college does that. We did.

We don't hire a single technician at Brevard Community College for aerospace, and never will. They hire them all. And they become true partners because they have ownership in the program.

The program is, in fact, rooted in time. This is a program plan, it would look familiar to anybody working in aerospace. The green shows what has been accomplished, the light blue what is in work, the dark blue, what comes next.

And just very quickly, in fact, we predated this, probably around 1999, developed the degree program, secured funding from the state of Florida.

That was a million dollar funding, it helped build some of the laboratories and kicked this all off.

Last year, in July, we achieved the National Science Foundation designation as a National Center of Excellence for aerospace technical education. There are only 12 national centers for community colleges, we are one of them.

That was a three million dollar grant, which sounds great until you divide it by ten, and by three. Ten schools, three years, three million dollars. It is not a lot of money.

But we have been able to do a lot with it so far, and where we are headed is to emplace this national infrastructure, and to begin to transition to some kind of a fee-based sustainable process.

This is an example of what we call our Aerospace Technology Advisory Committee. And I would hope that we can interest all of you in partnering the way these folks have partnered. Al Wassal, are you in the room? I would like to see you sit up here, ex officio, alongside of NASA and the United States Air Force, as the FAA liaison to the Florida ATAC.

We are in the process of moving this to a national level. There will be ATACs at nine other locations across the country, each of them will probably provide two representatives to a national ATAC.

But I will tell you that what characterizes this, first of all, large number of government entities, large number of industry representatives, large number of academic all the way from K-12 to university level, including Embry-Riddle, some of you are familiar with, Florida Tech, and others.

All of the leadership positions are industry led. The Chair at Florida is a guy named George Hauer, who is the general manager for Wyle laboratories in Florida.

And these committee chairs are largely industry. I think one public relations is from the Florida Space Research Institute.

This is a map that shows the spread. If you are going to deal with international companies, large corporations, community colleges don't do that very well standing alone. They do a terrific job delivering in the local arena, and that is how we are structured.

But in order to deliver for the Lockheed Martins, and the Boeings, and the Wyle Laboratories, we needed a national infrastructure. The red dots are the active spaceTec members, find your state and you will see the community colleges that we are working through.

We have been collaborating now for a little over two years, a little less than one year, formally, and funded by NSF. You can see that we will probably add active members in the Colorado area.

You will notice that all of these colleges are adjacent to NASA or DOD aerospace facilities, and that is by design.

I'm going to use this to shortcut about three charts that follow, and I will apologize. Somewhere between Florida and Washington, D.C., somebody in the U.S. Postal Service, I will have to talk to Bob Walker about this, got my charts, and they didn't show up in your book.

What is out there is a pamphlet, and our first newsletter from Space Talk. Some of them were on the table, others are out in the lobby area. But please make a note. If you would like a copy of the entire set of briefing charts, write to me at alkoller@mac.com, and I will send you the briefing by email, no problem at all.

You can see that the vision is a pretty lofty one. We are to be a national resource for aerospace technical education. We are to emplace a national infrastructure for curriculum, validation, and delivery. I'm not sure it has ever been done before.

Colleges are notoriously independent. And getting them to collaborate on anything is difficult. When you are talking about curriculum and degree collaboration, you are at the pinnacle.

We have already achieved much more than I would have imagined, and I will say more about that, briefly. To emplace some kind of a national skills standard program, and we find that we get in trouble when we use the C word.

Because when we mean C, we are talking about skills and performance certifications. But when our contractor counterpart say the C word, they are talking about stand boards and task level certifications, which is how the business is done today.

So we are going to change that to say national skills certification program. And, of course, the national data bases, and all the things that go with it. Look at the outputs, Associate degrees, national articulation with our own community colleges, and then with others of the 1,300 that exist in this country.

Two plus two articulation with universities, private and public; continuing education and technician career development. I don't know whether you realize it or not, but there are no formal structures to promote and enhance career development for aerospace technicians in this country, beyond those that are company-based.

There are wonderful company-based systems, but if you change companies you start from zero. You start over again, your training goes to zero. Companies do not accept even the fundamental training in safety and quality from one another.

And we are in the process of remedying that. In addition to that, there is no AIAA, or IEEE, or ASME for aerospace technicians. There is no national conference, there are no national journals, there are no national data bases.

And a year from now I hope to be able to come back and tell you that all of those are in place, because that process is now underway.

In terms of K-12, faculty workshops are already under way, so we are doing outreach to our own faculty, and then to others, both upwards and downwards in the chain of command.

And we are also looking at enriching the K-12 curriculum. You just saw that from Ed, and some of the NASA work. We know that there is some magic in that space dust.

I'm amazed, if you pooled your own

children, you would be astonished at their lack of enthusiasm for aerospace. I was devastated. In our area, which is the free world's launch site for manned space, in ten focus groups, made up mostly of Boy Scouts and Girl Scouts, there was not a single child who chose aerospace for a career, not one.

Why would that be? Because none of those children were alive when Neil Armstrong stepped on the moon. To them Apollo is a paragraph in a history book. Fact, so we have some work to do.

And, finally, recruitment and pathway implementation, so that we can bring people into the technical work force. I'm not going to dwell on this one. Next.

Just briefly, this is probably our next most important. To nationalize the program we need to get our advisory committees out of the local, and at the national level. If you have any interest at all, from an industry or company standpoint, or from an agency standpoint, please be in touch with me. This is the formative stage, is when we can use most the help you could give.

Just a pictorial, I won't dwell very much on it, except to say that today there is a lot of industry proprietary training. There is a lot of general education going on in the colleges, never the twain shall meet.

Our job is to figure out how to develop this solution set, where we can blend skills and knowledges from both sides. The program is very hands-on. Please don't be misled, this is not a pre-engineering curriculum, this is hands-on technician level, down and dirty, turn the wrenches, learn how to use screwdrivers kinds of work.

That is the Army of people who underpin aerospace, not only in this country, but anywhere else in the world. Engineers don't do a terrific job of repairing heating, air conditioning, television sets, that is technician work, and we are trying to aim it correctly, and it is a constant battle for me to keep people out of the office with calculus, and calculus based physics, because technicians will never use that. If you are going to pre-engineering you use that stuff, don't come here, different game.

It is very hard to stay focused, we are in the process of doing that. We do have a website. I would refer you to that, wwwspacetec.org.

I probably need to say just a couple of words here. I have already told you we have, in place, eight different programs across the country. One at

Brevard, four at Calhoun community College, Decatur, Alabama, mostly tied to Boeing and Delta IV, and there at the Community College of the Air Force.

There currently are 134 students active in the two programs, the four rather, the five I guess. Four at Calhoun and one at Brevard. WE will graduate our first students in May, and we are in the process of recruiting for the next group.

Some facilities are in place, including laboratories, a twelve million dollar center for aerospace training at Calhoun, and some major partnerships. And I will just say a word about that.

This one is very important to me, because it recognizes a partnership between BCC, the Florida Space Authority, and the 45th Space Wing, that has set aside a building, 4,400 square feet with shops and labs, and is in the process of designating launch complex 47 on an active national range at Cape Canaveral Air Force Station, for the purpose of promoting educational opportunities.

We will be able to take our technicians in there and conduct refurbishment, maintenance, repair, launch operations, magic kinds of stuff.

You probably know most of these, we have been impacted by all of them. We were, in fact, highlighted in the Walker Commission report as one of the islands of excellence. I framed that and put it up and said, my God, I hope we can live up to that.

It looks good right now, we are in our seventh month. That is pretty early in the game. But we will see what happens next.

And, finally, the three year NSF grant was the motivation we needed to go on beyond that. We brought to the table more than our industry partners have, at this point in time, in terms of hard cold cash for that.

I will go by this one, please. Let me just spend a moment on this one. And, Camilla, just forgive me, I don't want to miss this opportunity, because it comes back to a reminder of what this means to all of us.

And I will see if I can recite this little poem for you. Isn't it strange that princes, and kings, and clowns that caper in straw dust rings, and common folk like you and me, are builders for all eternity? To each is given a bag of tools, a pile of rock, and a book of rules, and each must make -- life is flown, a stumbling block, or a stepping stone.

Ladies and gentlemen, every one of us leaves a legacy. A few of the lucky ones shape the legacy. We lost seven courageous astronauts this month. And my colleague, Dave Brotemarkle would say don't mourn for them, they lost their lives doing what they loved to do best.

We mourn for the families, we mourn for the loss of talent. But if you really want to feel sorry, feel sorry for the person, millions of them, who never venture outside the survival area. They never take any risks, they never have a vision of what the world could be.

This is a chance to take us to the next step with our kids. If you have any talents at all, that you would like to share, mentoring, teaching, internships, scholarships, equipment, training aides, we need you now, please step up to bat.

Thank you.

(Applause.)

MS. MCARTHUR: That was an excellent presentation. And, actually, it is the heart of what we are trying to do with this particular panel. But we did promise the attendees that we would let them know that it was 12:30, but we will continue with the panel discussions.

We do have another speaker, and we will have the question and answer session. So at this point we are going to go forward. Our next speaker is Mr. Jim Pagliasotti.

MR. PAGLIASOTTI: If you all are as hungry as I am, you will appreciate the brevity of my remarks.

Unlike my colleagues on this panel I'm not a professional educator. I usually begin by saying that I am a father of four children, three of whom are living, and one of whom is a teenager.

But my teenager just turned 20, so I'm going to have to get a different opening. Like parents everywhere I've always had an interest in education, and I was fortunate, during the 1990s, and the infancy of the Aerospace States Association, to have the opportunity to represent that group of people and states as executive director.

The one thing we had in common, among our many interests, the one thing we had in common is an appreciation for the value of education, the importance of that process to our future work force.

Much of what you have seen here covers the value of space education. I don't think any of us can doubt that. We all know the old cliche about space and dinosaurs being the two things that interest young children.

NASA being very savvy now has a program

called Astro Biology, where we are looking for dinosaurs in space, so they should have a winner there.

But I do think that it is important for all of us to recognize, and I'm here to tell you what I learned. But the critical part of reaching our children, and doing the things that all of these profesionals are trying to do, the critical part is in working with the delivery system.

And the delivery system for education is a teacher in the classroom. We, at ASA, our very first experience was a program that became known as rockets for schools, which was funded by a very small grant, but a very generous grant, from the old office of commercial space transportation.

We did it with the Spaceport Florida Authority. And my good friend Chuck Kline, who may be in the room, was down with us. We brought kids from around the country for a week's intensive training in aerospace technology, including some at Brevard, as a matter of fact, and had a great time down in the space coast.

When we got back from that we were very revved up, and we wanted to do something that would reach a lot more kids. And quickly concluded that the way you reach kids is through their teachers.

So we put together a number of programs. In Colorado we went out and tried to find the best teachers we could. And, again, with the support of the federal government, in this case NASA, we were able to put together some programs that were very effective.

It was all taking place, and that standards based education was coming into being. And what we quickly learned is that you are not always welcomed when you go forward with good intentions.

The teacher said to us, you know what? Space is great, but I don't need more stuff to do, I need help, I don't need more stuff. So we were able to conclude from that, being not the brightest in the world, but pretty obvious point being made, that what teachers needed help with was meeting the standards based education requirements they were being handed.

They were not comfortable with them, they were not familiar with them, there was a lot to do. I'm going to make this very short, because my colleagues all over the country have engaged in programs, just like we did in Colorado, programs that provided very substantial help, we believe, to teachers in meeting the education standards in their states.

The single most important thing we were able to do in getting this message out, this excitement out that my colleagues have spoken about, to the children of this country, was to help teachers collate and index space education programs to state standards and education.

And I'm not talking just in math and science. In Colorado we worked to make sure that there was a space education continuing to the earth sciences and space sciences component of our state-wide standards.

We were able to provide programs that included music that met standards. Not that we have music standards yet, but there were standard based programs that teachers could use, and they were all space education based.

I don't want to take your time. As I said, I'm very hungry. I just want to express to all of you that I'm very proud of my colleagues in the Aerospace States Association, because it is not easy to do what they've done, and they've done it as volunteers.

They have gone out and worked because they believed in the very things that these gentlemen are talking to you about. I want to congratulate Patti, as always, for giving all of us this opportunity to get together and discuss these ideas.

I think whatever your interests are, you must recognize, as we have come to recognize, that education underlies it all. It underlies our well-being, and it underlies the future.

And so we, at the Aerospace States Association are very pleased to have been able to engage in this process, on behalf of all of us, and look forward to working with you again.

I hope we can continue down this path. The message is short and simple. Whatever you do, if you want to keep it from being something other than just a fringe player in this education effort, makes sure that it is tied to your local state education standards. The teachers will love you, and the kids will benefit.

Thank you very much.

(Applause.)

MS. MCARTHUR: Okay, now if you want to, we will engage in a question and answer session. Does anyone have any questions? Sir, is your hand up?

MR. SCANDURA: You were talking about aerospace technician programs, those types of things. What involvement, if any, does your group have with the FAA commercial side of the house, that has FAA certified technicians, those type of things?

MR. KOLLER: That is ANP licensing, different game entirely. So, really, except for the fact that we have borrowed, liberally, from the approaches they've used in the curriculum, because obviously there are very many common skill sets, that has been the extent, thus far.

One of the reasons that I look forward to having Al serve on the team to make that linkage even tighter for the future, than it has been.

MR. SCANDURA: So basically there is a model there that -- you are using it as a model for reference?

MR. KOLLER: Yes.

MR. SCANDURA: That is what I had hoped.

MR. KOLLER: But we are also using things like the Automotive Service Excellence Program, for automotive mechanics across the country, because those are very hands-on examples.

MR. JACKSON: I agree with something that was said in one of the panels. And that is that education is extremely important, especially for our youth.

And a lot of the times the educational process that we see is focusing on the university level people, students and so forth. But from my experience, and I spent several years working as a technical coordinator for a minority engineering program, which introduced kids to engineering, and I insisted upon using high school kids, I insisted on having not just the A students, because the A students would be fine, but I wanted B students in that group.

And I insisted on having a structured program where they challenged each other. I won't get into what they've done, but I will get to the point where we even stayed later, the company I was working for, they requested it, because I had a due date.

So the point that I'm getting at with all this, is that I think that we have to be very cognizant of the fact that we have to focus on the youth, youth back in elementary school, I believe, that we have to start from that level on.

Because I go around, I speak to kids, and even FAA had a mentor day with kids that came in, and a lot of these kids don't want to go into science, they don't want to touch it, they are not exposed to the fact that it is not -- it is difficult, but it is not as difficult as they think.

So how can, any of the panelists, how can we make a change at the attitude, and allow these kids, younger, that will accept a science field that will move into, hopefully, aerospace or whatever the discipline at that point, and not be so much afraid, so that we can maintain that skill level that we need in this country to move forward in the future?

Anyone can answer, thank you.

MR. KOLLER: I don't have the whole answer, but I will give you two examples. Last summer we did a rocket workshop at the college picnic. We captured every kid at the picnic. None of us ate food that night because their parents left us after a while, the line was a mile long.

We were launching air launch rockets made out of construction paper. I never would have believed that you could get that done.

This summer we will host two high school classes to two, three week clinics. That is the beginning of what I think will be a much greater outreach.

One is at the elementary, or middle school level, probably fifth grade is where you need to target, if you are really going to channel kids. It is too late if you wait until they get to middle school, really, fifth grade.

But the other is those high school kids. And I couldn't agree more in terms of not the A student, the A student will be taken care of well. We are looking at what is called the forgotten majority, those students who fall through the cracks.

But also those ones who can walk up and look at a black box and tell you how it works, it is a talent. It is going to be a neat time, and I hope all of our colleagues at those other eight or nine locations will follow suit.

MS. MCARTHUR: Dr, Kubota, do you want to share something about how they do it in Japan?

DR. KUBOTA: Well, it is very difficult how to change that situation. But we have some contest of rocket launching, water rocket launching. We have some power plant bottle for drinking, and then to fill up in water. And then push in to make thrust.

And we have such a contest in middle, elementary school level, and junior high school levels. It is by Young Astronautic Club in Japan. So we have many, many branches in Japan.

So we have some contest every year, every time. So my dream is, in a contest in United States elementary school, and Japanese elementary school, each other, once in United States and once in Japan so our many elementary school children coming to make water rocket, water rocket launching contest, competition.

MS. MCARTHUR: Did anyone else have any more questions?

(No response.)

MS. MCARTHUR: All right, then, thank you very much for joining us for this panel.

MODERATOR MURRAY: I wanted to thank everybody for hanging in there with us. We will be reconvening at 2 o'clock for our panel entitled, Space Propulsion Issues and Challenges for the 21st Century.

So we will see you all back at 2 o'clock.

(Whereupon, at 12:52 p.m., the above-entitled matter was recessed for lunch.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

2:12 p.m.

MODERATOR MURRAY: This afternoon we have one last panel, and it is entitled Space Propulsion Issues and Challenges for the 21st Century.

Our panel moderator is Frank Sietzen, Jr., and he was named president of the Space Transportation Association in 2002, after a 21 year career as a journalist, writer, and editor for such publications as Aerospace America, Space Business News, Military Space, and UPI.

He is the author of three books, has a fourth set for publication next year on the political history of the space shuttle, and has written about human space flight launch and commercial space related issues.

Please welcome Mr. Frank Sietzen, Jr.

MR. SIETZEN: Thank you very much and good afternoon to you all.

Former Air Force Secretary Sheila Widnall had a line that was a sure-fire joke getter during her time in the first Bill Clinton Administration.

She liked to say that the Earth was covered by two-thirds water, and one-third launch studies. We have, indeed, studied every conceivable type of launch vehicle to assure U.S. access to space.

From the fully reusable, to the partially reusable, to all sorts of variations on the theme of expendables. And all along this country has remained dependent upon that first generation machine whose health and restoration to flight is the current number one national space transportation priority.

The future of the space shuttle may be clouded today, but we believe it should not be in doubt. Nor should the future of the U.S. expendable launch providers.

But no matter what type of launch vehicle we seek to sustain, or to develop anew, all will require a healthy growing, and advancing U.S. space propulsion industry.

Now, what do I mean by that? Well, I think it means a renewed and sustained commitment by NASA and DOD to fully fund the R&D technical base that this industry requires in the years ahead.

It means that the next generation launch technology program must be funded at a level that allows test and research in both hydrocarbon and cryogenic liquid engines, advanced forms of in-space propulsion, and the appropriate role of solid propulsion.

It means fully funding the integrated high payoff rocket propulsion technology program. Also called IHPRPT. In short, it means all of the players playing their respective roles to continue to develop our industry.

This afternoon four leaders of that industry will give us their unique perspectives on both some of our most recent success stories, as well as issues that they believe are facing the space propulsion community.

Our speakers will be representing Boeing Rocketdyne, ATK Thiokol, Aerojet, and Pratt & Whitney space propulsion. SGA and the FAA are pleased to have with us today Mr. Byron Wood, vice president and general manager of Rocketdyne Propulsion and Power, Integrated Defense Systems of the Boeing Company.

Oren B. Phillips, vice president of business development of ATK Thiokol Propulsion; Julie Van Kleek, executive director for space systems for Aerojet, and Don McMonagle with Pratt & Whitney Space Propulsion.

Byron Wood has nearly 40 years experience in the area of launch vehicle propulsion. His job is to oversee the space shuttle main engines, EELV booster engines for the delta family of expendable vehicles, and advance propulsion and power systems.

Mr. Wood joined Rocketdyne in 1963, and was responsible for the Saturn 5 J2 engine. And following that the SSME development program. His subsequent work resulted in the company's development of the RS68 engine for the Delta 4 family, the first new U.S. large liquid rocket engine in more than two decades.

Mr. Wood is a graduate of the University of California at Berkeley, with degrees in physics and mathematics, and has won the NASA exceptional engineering achievement medal, the NASA public service medal, and was named, in 1994 the San Fernando Valley Engineers Counsel, Engineer of the year.

Oren B. Phillips was named ATK Thiokol vice president of business development in 1997. Since 1995 he has also been the vice president of ATK Thiokol Technologies International, a wholly owned subsidiary of ATK.

He joined Thiokol in 1967 at the firm's government systems division in Elkton, Maryland. There he led the development, marketing, and flight programs of the Star 37 series of solid rocket motors.

In 1984 he was appointed Thiokol's general manager at their Louisiana division in Shreveport, Louisiana. Two years later he was named vice president of business development in Morton Thiokol's Aerospace

Group in Ogden, Utah.

From 1995 to 1996 he served as director of space and launch vehicles for the DLV division, and led the transfer and qualifications of space products from Thiokol facilities in Alabama, and Utah, to Japan, and Russia, and Spain, opening new markets along the way.

He holds a Bachelors of Science Degree from the University of Delaware, majoring in Mechanical Engineering, and many technical honors, including Chair of the Aerospace Industries Association Space Committee; Chair of the University of Utah College of Engineering Industry Advisory Board; and Member of the Board of the Utah State Research Foundation.

Julie Van Kleek is Aerojet's executive director for space systems, is responsible for the strategic development and business growth of Aerojet's space propulsion business.

She holds degrees in both mechanical and aeronautical engineering, graduating summa cum laude from the University of California, at Davis.

Her expertise is in the areas of rocket engine combustion design and testing, composite materials, life cycle cost modeling, and launch vehicle trajectory analysis.

She has awards for her role in developing the advanced liquid axial system, overall advancement of liquid rocket systems technology, and for managing Aerojet's successful bid for the Atlas V EELV solid rocket program.

And we have, as we are delighted to say, a fourth speaker not on your plan, Donald R. McMonagle, who is the director of business strategic planning and advanced programs for Pratt & Whitney.

He is a three time shuttle astronaut who has flown on STS-39, 54, and 66. And I hope I have those three missions correctly. And he will talk about Pratt & Whitney's development of, I suspect, the RS-68.

Now, I'm in big trouble up here, because I'm surrounded by more rocket scientists than I had ever hoped to be surrounded by. So, Patti Grace Smith, if you are still around, you may have to come rescue me in helping to explain what the heck they are talking about.

Because I'm a poli sci major, and I must tell you, the last science course I took was how to dissect a frog.

Ladies and gentlemen, we will have each of our speakers, beginning with Mr. Wood, and after which we will have questions. If you would direct your question to a specific individual, identifying yourself and your affiliation, we would appreciate it.

And now Mr. Wood.

MR. WOOD: Thank you, Frank. It is my pleasure to be here this afternoon to talk about the situation or status, and challenges in the space industry with respect to propulsion.

I think it is very appropriate, and the Commission report on the future of the United States aerospace industry, that they talk about creating a space imperative for development of new propulsion and power.

I think that is a very important statement to have been made, and I hope some of the data that I will show you today makes that even clearer to all of you, and I seek your support in helping us to turn that around.

Let me talk a little bit about Rocketdyne, just in case you are not aware of it. First of all Rocketdyne is a business within the Boeing company, it is located near Los Angeles, in California.

Our 2002 sales were, approximately, 650 million. We basically are in propulsion programs that include the SSME, the expendable launch engine systems for Atlas II, Delta II, and III, and most recently Delta IV.

We are in the missile defense business, in

THAD. We are in various programs in advanced propulsion, including the space launch initiative, the GEN2, the GEN3 hypersonic combined cycle work, IHPRPT, and an array of various technologies.

We are also the developer and integrater of the power system for the space station. And we are well into nuclear electric propulsion, and are very encouraged by the recent work in the nuclear space initiative.

We are also entering into the production of electricity through fossil fuel power as well as solar power. We have been in business 50 years, actually 52 to be exact, and have had over 1,500 launches, and have put 750 humans in space.

Let's talk about the liquid challenges, and put that in the perspective of where have we been over the years. The first challenge, as I view it, started in the late '50s, early into the '60s, and that was to step up to the cold war threat.

And that was, of course, a technical challenge, you know, who will control the oceans of space. And the race was on. And, believe it or not, some of the engines that we developed in those days, a picture you will see there on the right, is an engine that is still flying, believe it or not.

That first challenge quickly transitioned into meeting national pride expectations to be able to go to the moon. That, again, was largely technical.

One very interesting thing is perhaps one of the largest most capable engines ever developed in this country, the F-1, has been sitting on the shelf now for 30 years.

That, in turn, transitioned into reusable space access, where technical was top of the list, but cost expectations were part of the challenge, and that persisted through the late '60s and into the '70s. And, of course, that engine has been flying now for 22 years, and is unmatched in the world, in terms of its capability, specifically reusability.

That brought us to the most recent challenge in the late '90s, affordability which now, of course, is something that was purely technical with cost, kind of as a secondary issue, to one in which cost was the primary issue.

And that brought on the challenge for the RS-68. And maybe I should bring Don up to do this part. The RS-68 development challenge, what I'm showing you here in one chart is kind of the bottom line of all this.

I'm showing you a plot of non-recurring

costs, the development costs in 2001 dollars. And so I've taken the three engines that you see in the upper right part of the chart, the two Apollo engines and the SSME, and I show you there the number of engines, the number of tests that were required to bring those engines to the point of being able to fly the first time.

And you can see the associated cost of developing those engines, on the scale on the left. At the bottom I talk about the cycle time. So, for example, the SSME took nearly ten years to develop.

And, of course, there was a lot of technical challenges to do that. Our challenge in the RS-68 was to make major improvements in not only the cost, but the cycle time to produce the engine, which we were able to do. We were able to produce an RS-68 with 12 engines.

We had a target of 150 tests. We were able to accomplish it in 183 tests, and we did it in four years and eight months. So depending on your frame of reference from this chart, we reduced the cost by a factor of four to six in the cycle time, up to 55 percent.

So we thought we had done a really good job on this. And so we said we developed processes and capabilities that will now serve us well in the future.

But what happened? Let's look at the next chart. We had tremendous process development and cost improvements. The data that you see in this chart, in terms of the development or non-recurring costs compares, again, SSME to RS-68.

And believe it or not, even though we reduced the cost of developing an engine, by a factor of six, the only thing we hear about is our rates are too high. That is an amazing thing. We won the battle and lost the war.

The rates are up between then and now because they install bases down, because the business hasn't shown up, so the utilization of facilities is there, so the message in all of this is that the community does not want us to have facilities and capacity to build these engines, they are more interested in what are our rates. An interesting perspective.

So where does that all leave us in terms of today? Today the liquid rocket propulsion industry has become an array of beggars and prostitutes. We are at the threshold of disappearing.

So industry survival is our biggest challenge. Market and national agenda, let's talk about that very quickly in a few areas. Next chart.

What I have compared here is the United States in the middle to the Far East on one side of the chart, to Europe and Russia on the other side of the chart. Certainly our business health is in severe decline, compared to both sides of our oceans that are well supported by the government.

Not as well as they would like, or as well as it used to be, but nevertheless supported. Global competition is at our door every day. And because of regulations on ITAR, our ability to go the other direction is prevented.

In the far east we have programs that are militarily driven with national pride. In Europe and Russia they usually contributes to maintain growing capability in Russia. Europe and Russia are teaming.

We have the situation where design and development are growing fast in the far east, and we face the competition of Russian labor at one-fiftieth of the cost of what it is in the United States.

And so the end result is the business health in the United States of liquid propulsion is going in the tank, with the human capital associated is severely in erosion.

This is a picture of Rocketdyne launch

business, number of launches versus years. The blue bars represent our estimate at the beginning of each year, that is based on our customers telling us what they plan for launch.

So we do it for the year that we are starting, plus projecting it for two years in the future. So you can see, by looking at this data, that every year what launch people tell us they are going to launch never happens, to the tune of maybe 80 percent or even 50 percent of what they tell us.

Now, these aren't because of engine issues, these are because of other things that happen in the industry as we go. But the alarming event is the fact that the number of actual launches, you can see, now has decreased more than 50 percent from where I started this chart in 1997.

The other disappointing fact in all of this is that many of the businesses that we now deal with, in terms of launches, are providing to us margins in the contract that are between 6 and 10 percent, 6 and 10 percent margins don't get it done. The cost of capital today is ten percent. So we can't even cover the cost of our assets.

What does it look like from a market share point of view? In 2002 there were 269 engines launched in the world of the class that we typically address. And if you break that into where were they launched, 57 percent of these launches came from Russia, 20 percent in Europe.

Only 17 percent in the United States. We are a third-rate propulsion industry. Six percent in the far east, but they are trying to grow that very fast.

Next chart. One of the issues is what is happening with security versus civil, or is it civil and security, or is it together, or is it one or the other, who knows?

The space shuttle has been flying since 1980, some people say it will fly until 2012, 2020, or 2050. What the Columbia accident will do to this is anyone's speculation.

Single-stage-to-orbit is dead. DCS, X-33. The EELVs, which were the promise of the future, and expendables, are gasping. Two-stage-to-orbit, we are on the shelf. Just this last year, and combined cycle in the 20-20 region is everybody's utopia, but significantly underfunded, if it is ever going to do anything.

Next chart. This is the kind of technology investment that is going on. This is a study that we did in conjunction with the industry, for 2001. What it shows is that rocket propulsion, compared to jet engine design and development technology is a factor of two and a half below that.

The investment in jet engines has yielded tremendous capabilities, and abilities to improve that system. It needs to happen in rocket engines as well.

Next chart. Let's look at what liquid rocket engine development looks like from 1940 to the present. And you can see the number of programs there, and the time span that they were in development.

The sad thing about this chart is that best we can tell today, this industry might end in 2006. In spite of what you might read, and if we look at history, in the last several years, there is a very good chance, in this country, that there will no longer be a government funded propulsion program beyond 2006.

Next chart. This is what that would look like, in terms of human capital erosion. Two lines here, one represents government funded people, the other one represents non-government funded people.

This particular chart peaks at about 2000 people in 1998. You can see that the non-government, or private investment has basically dried up. And our projection on this plot today says that by 2006 the combined total industry, not just Rocketdyne, but the combined total industry will be below the level that we used when we developed the RS-68.

In other words, we will not have the ability to design and develop another engine in this country. And why will that be? Next chart. We are on a downside of the skill cycle.

In rocket propulsion, which has a life cycle of maybe 20 years, it needs to be fed at the front end or ultimately it is going to die. And that is what we see, and it is an alarming situation.

Which brings me to this point. So today the U.S. has the capability and the technology to meet the challenges of propulsion near term, but for how long is anyone's guess. It has the capacity to meet U.S. goals, but those are eroding fast.

We can no longer afford to maintain the infrastructure, fixed asset base, or capability to do this any longer. So the U.S. must act soon to maintain its leadership in propulsion, or it will lose its sovereign accessibility.

Next chart. And so one would really ask, who will control the oceans of space going forward? Sobering question. Thank you.

MR. PHILLIPS: It is good to see all of you here this afternoon. I want to thank AST for providing this forum for us.

I will also be addressing similar information that Byron addressed. And this panel really represents the entire propulsion capacity of this country.

So as we look into the future, whether RLV, whatever is next, the next 10 or 20 years to that next step, is going to be dependent on whether companies like ours continue to have the ability to support the initiative.

In that regard Commissioner Walker this morning addressed some of the industrial based concerns. I'm going to try to expand on that. I would like to express my appreciation to Dr. Koller, this morning, for the enthusiasm brought to this forum in regard to trying to encourage the investment of all of us in creating the next generation of scientists and engineers.

So I'm going to spend a little bit of time discussing the industrial base, how we maintain core competency going forward. And with that, obviously, indirectly address competitiveness issues.

Who is ATK Thiokol Propulsion? About two years ago the number one and number two solid propulsion companies in this country merged, ATK acquiring Thiokol

Propulsion. Not to boast, because we take our role very, very seriously.

But we provide propulsion for, essentially, every asset launched into space with the intention of defense from space. All human space fuel flies on our solid boosters. Nearly every expendable launch vehicle, large or small, we provide propulsion and/or composites to support those missions.

We are the bottom end of all ground missile defense, and we manage and produce all strategic missiles produced in this country. Next, please.

Why did we merge? Both companies shared a concern about being able to maintain core competency, bear the cost of heavily capitalized facilities, and we knew that the market was going to continue to be in decline.

The market over the past ten years, for solid propulsion, has indeed declined over 50 percent. That drove our consolidation.

Going forward, if everything we are talking about, whether it is moon, or RLVs, or satisfying the missile defense requirements of this country is going to occur over the next ten to twenty years.

What is going to happen in solid propulsion over the next ten to twenty years? We are already seeing substantially reduced rates for EELV. The shuttle prior to Columbia was undergoing a rate of flight reduction.

Titan has come to a conclusion, which is the second largest solid propulsion system in the United States. Trident D5 submarine ballistic missiles are being ramped down, and over the next five years we will complete the rebuild of the Minuteman III fleet.

No new major programs for development are on the horizon. And sometime between now and 2012, 2020, 2030, we hope it is years rather than months, the shuttle will be replaced.

And upon its replacement the shuttle program, representing capacity equal to all other solid propulsion programs that we expect to be at that time, will have a major impact on our core competencies, and ability to sustain solid based systems.

Put in a different context, we all enjoyed in the '50s, '60s, '70s, major capital and facility development. ATK Thiokol Propulsion if you don't know us, right now has 30,000 acres of plant in Utah, and hundreds and hundreds of thousands of square feet of manufacturing facilities.

We are currently operating at somewhere around 35 percent capacity. And as we predict our programs going down, as I enunciated in the previous chart, we will be approaching something in the order of 10 to 15 percent capacity over the next five to seven years.

If you are a manufacturer you know what kind of difficulty you are in if you are running against that kind of factory capacity.

Space shuttle. You know, when the afternoon of the Columbia loss I thought I really should redo some of these view graphs, and I said, no I don't really need to do that, because the impact is potentially greater than Saturday early morning.

But the fact remains the shuttle program is unique to the solid propulsion industry. One, it is absolutely the largest program. It carries most of the engineering core competencies resident in the solid propulsion industry.

There are a lot of important factors about the space shuttle. Depending on the materials it now represents somewhere from 60 to 95 percent of all those materials purchased in the United States, to support all the solid propulsion. Just that one program.

The shuttle is unique in another way. We test the shuttle every 12 to 18 months, we fully inspect the hardware after every flight. It is the one program in the country that has the testing program in place to introduce and evaluate materials that are having to be replaced because of obsolescence, for whatever reason, and then it creates the new base of materials for all solid propulsion, and in many ways liquid propulsion as well.

And we get confirmation after every flight that, indeed, the ground test was a validation of the materials and the processes that were changed through the year to year evolution of this industry.

Next, please. Here, I think, is one of the most disconcerting, partly as a father, because my daughter has just started in engineering school, is the introduction of not only youth and energy, but the creativity that comes with that youth, the ability to say, I may not know better, so I will try something new.

And our industry is in real trouble. Eight percent of ATK Thiokol's work force is now under 35. We have to sustain, if we are going to fly EELVs, the EELVs ought to have a 20 to 30 year life, there are not going to be many around at the end of that program, that are with us today.

So like you we are all searching for solutions to develop, and train, and introduce young people into our industry, that have the will, and the wherewithal, to bring the best of solutions, and talent, to sustain what we think is really a national enterprise that is important to this country and our people.

We are going to be with you as new solutions are evolved. We have been doing that a long time. Rocketdyne, Byron Wood, have been doing, our industry has not been static. It has required us, time and time again, to invest and find new solutions.

Some have been with wonderful results, some with marked disappointments. About ten years ago we initiated the Castor 120 program. New booster, which was later used for Taurus and Athena.

The investment by ATK Thiokol was 70 million dollars. And we all know what happened to the small satellite market place. And if anybody can remember when the last Athena or Taurus flew, you are in the minority.

Talk about core capacity, it is the ability to identify a market and move quickly. The GEM-60 was developed and qualified in 29 months. And we flew it on the Delta IV initial flight a few months ago.

That is what I'm talking about, about maintaining robustness, not only on your own competency, but a material supply chain that you can go to, and find solutions.

We look at dual use. Core competencies in engineering and materials go back and forth between all the propulsion competencies, and we are able to introduce a brand of the shuttle nozzle exit cone, from the ablative exit cone for the RS-68 for Delta IV which, again, flew recently.

As far as technology, and when I meet with college students trying to convince them to come in as a co-op or a new hire, fresh out into the industry, what is the one thing bright engineers and scientists want to do? They don't want to go on production programs.

They want to tap into leading edge technology so that they feel that they are on the horizon, and are creating something that they can call their own, a few years into their career.

And we have had a terrible decline in research and development in this country. Other pathways to maintaining competency, some, but it is going to take all of us to go together.

We love the advocacy of those who are reaching way out into the stars because that is the drive we are all talking about, the destiny of our applications, and adventure into space.

We get back to pretty mundane things in order to stay alive and stay competent. The shuttle must continue to fly or we have, in this country, maybe a problem we can't solve as far as access to space.

Material supply will dry up almost immediately, engineering skills will follow shortly thereafter, and no young talent will join an industry at that level of distress.

Assuming the shuttle will continue to fly, and I do believe it will, we have to be all advocates of continuation of focused, and non-focused research and development in this country.

Obviously the IHPRPT program, the propulsion applications programs, and the engineering sustainment programs and the various propulsion campaigns in this country need to be sustained, increased, and supported.

You know, when I started very many years ago, by the time I was 25 or 26 I was leading the creation of the Star motor program. And one of the things that really got me involved is climbing up on pad 17 my first time as also the program manager at that time for the third stage on Delta II, when we incorporated the 37 inch motor third stage.

And going up on top of that gantry, and a couple of days later participating in the flight review, pre-flight go meeting, and then sitting back and watching it go.

It is one thing to put technology on the shelf, it is another to take it to fruition and demonstration. Whether that demonstration is all that was expected, or not, is part of the learning and doing, and we need to get back to experimental flight programs in this country.

Take the technology to space, whether it is propulsion, whether it is guidance, whether it is flight controls, whether it is safety systems, whether it is satellite competencies, take it to orbit and see what We've got.

And, obviously, the last point as these markets continue to collapse, and be reduced, we are going to need to look at ways, by law, regulation, and the support of business, to rationalize the industry, and continue consolidation.

Thank you.

(Applause.)

MS. VAN KLEEK: I have to wait for view graphs, because I left my disk in the Washington office, so it will just be a few minutes.

What I would like to do is present Aerojet's views of the propulsion industry. And what I will be doing is talking about some current recent challenges that We've had, both talking about the positives of those, as well as some of the difficult things.

And then looking toward the future. And you will hear some similar remarks, you know, in my presentation, as the previous two speakers, maybe told from a slightly different perspective. But, again, you will hear some similarities.

Aerojet is -- has been in the business for about 50 years in propulsion. We started during World War II, supplying the JATOs. So we have been here since the beginning. The company has changed its complexion quite a bit over that history, it has been fairly dynamic, had a very large buildup in the '60s, during the cold war.

It got up to an employment level of about 24,000 employees, building liquid, solids, nuclear, you name it, whatever propulsion there was, we were building it.

After the Apollo, and the shuttle awards, we then went through a fairly significant decline, down to about 2,000 employees, actually as low as 1,500. And then since the end of the cold war have been also changing complexions, and merging companies, etcetera.

Today we are a company of about 273 to 300 million dollar sales. We cover a pretty broad range of propulsion. We work in space, we work in defense, we work commercial, we work government.

In 2002 we acquired GD Space Systems, which was formerly the Rocket Research Company, also known as OLIN, also known as Primex. The corporation is committed to growing propulsion. That is a big challenge these days, given that very few of the markets we work in are growth markets.

Our growth will be through acquisition mergers, at least that is our intent at this point. As we go forward, with 300 million dollars, our base and capabilities to service all those different propulsion areas is a major challenge.

It is also a positive in some ways, when part of the industry is down, hopefully some areas are up. We work heavily in missile defense which, in or space business not being in the best of shape these days, missile defense is certainly a welcome change.

But as you look to the future, and I truly believe that companies will stay in business, they will adapt and they will change to what the environment is, but we do have some real challenges in terms of maintaining certain capabilities that I think, really, could disappear here in the next decade if something isn't consciously done.

So today what I will do is I will go through some current and recent programs, and then talk a little bit about some of the interesting technical achievements and successes, because despite some of the gloomy things, there are some really good things happening in the industry and propulsion.

I have been working in this area for 2 years, and we are doing some interesting things, finally. There were some good things in the mid '80s, but we are doing some more good things in space now. I just hope we will have the chance to sustain them.

I will draw some general observations of those different programs, to kind of discuss the environment, and then we will look at some other indicators in the program, to show what we see in the future.

Next chart, please. I would first like to talk about a current program right now, a very exciting program, that is the Atlas solid rocket motor.

This is a program whose purpose was to design, develop, and produce solid rocket motors for the Lockheed Martin Atlas family. We got this -- we won this program in, I think, '98.

And our challenge was to adapt Heritage

processes and components to a commercial environment, similar to what Byron was talking about in his presentation. We had skills and capabilities that could go into a rocket motor.

But being able to produce them for the type of costs and times that were required in the market was the big challenge. We had to adapt facilities, put in new facilities and then, frankly, retrain people in certain areas, since there hadn't been many solid rocket motors developed in the previous decade.

Currently we are in the final stages of qual. We are slated to launch in May on a Lockheed Martin Atlas V. And we do have production motors and final assembly ready to be shipped within the next few weeks.

Next chart, please. The Atlas V was built off many Heritage processes, from our ICBM days. It does have one advancement of the technology. We have a monolithic composite case, single piece case, that was developed both for technical as well as cost reasons.

It is about 60 inches in diameter. We supply anywhere from one to five solids for the Lockheed vehicle, depending on what the manifest is. Very lightweight, but does take advantage of many of our Heritage processes from our previous ICBM and ASRM days.

Next chart, please. When we won this contract we had the capability to certainly produce all these components, mix the propellent, etcetera. However, the facilities and the methods that we used were, you know, geared more toward a government ICBM program.

They were not going to allow us to meet either the time or the cost targets required for this solid rocket motor. So the corporation invested pretty heavily in a new facility that was designed specifically for this motor.

This was to be a long-term contract. Obviously, as with many of the products, and many of the other companies, we did set this up with the thought of a much healthier production base than we are currently experiencing.

So the, you know, investments were fairly high with the expectation of being able to produce anywhere from 30 to 50 motors per year. Currently we are going to be producing 7 to 10.

We are in the final stages of qual, we have tested for qualification motors at a variety of subscale test, completed our last VRS test last week. Again, if -- compared to what we had worked on, earlier in our Heritage for qual motors was a fairly slim program, but was given the Heritage components and processes, we deemed that to be appropriate for this type of program.

It also helped keep the development costs of this program down. As we go forward, and we field the new system, and people -- everybody wants it to be cheap but now we get into the basic infrastructure of how many questions do we have to answer, and so forth.

And so the reality of a four motor qual program is certainly something we are all living with now, and wishing that there were more.

Next chart, please. I would like to switch gears and talk about a couple of NASA programs. And the reason for doing this is these are fairly exciting programs when they lasted. But there is a common thread here that really does impact the current health of the industry.

The first program I have up here is the X-38 program. The X-38 was a propulsion system that was to be a prototype for the crew return vehicle that was in development at NASA in the late '90s and the early 2000s.

Our role in that was to provide the propulsion module and primary structure that would hold that. This was an expendable piece of propulsion that bolted on to the back end of the vehicle.

It was a primary interface with the shuttle. And then the vehicle would be stationed at the international space station. This propulsion module would kick it off of orbit, in the case of an emergency, and jettison the propulsion.

We worked on this contract with NASA Johnson, and NASA Marshall in the late '90s. The contract was structured such that we would have one prototype unit. That prototype unit would also fly on the flight vehicle, and then there would be five deliverable propulsion units for the crew return vehicle.

Again, it was a fairly challenging procurement structure. You know, we -- with the potential output of five production units, you know, we were really a fairly aggressive contract on the development, since they were put together as a single package.

We did develop, successfully, this unit. There were shifting requirements which drove overruns, which made this, you know, company investment required on this contract. But all along that was deemed okay as long as there was going to be production to come out of it.

Well, due to changes in the way that we are going to be approaching crew return on the international space station, this program was halted in 2001.

The hardware has been delivered, it is all sitting down at Johnson, but the probability of the production being turned back on is pretty low. So those options aren't exercised, and that is the current status.

Move on to the next program, please. Another program that we had going last year, and the year before, was out of NASA Space Launch Initiative, the COBRA program.

We did this as a joint venture partner with Pratt & Whitney. This was targeted at developing a hydrogen booster engine for the next generation reusable launch vehicle.

It had a lot of challenges to do this. One, we had to put together two companies that were, you know, traditionally had been competitors. Had to rebuild infrastructure that would cover both plants, put the learning together so that this truly could be done as a joint program.

And the exciting part of it is that we were really successful with all that. You know, we overcame the cultural differences, the challenges, driven by the fact that we were on two different coasts, and we actually had a very integrated, well running program that was making a lot of accomplishments.

Actually driving the state of the art, some new technical approaches were taken. We are doing subscale and full scale pre-burner tests, building manufacturing prototypes that would have been true advances in the state of the art.

And all this was going along very well and then in September, due to restructuring of NASA's go-forward plan, the ISP, the integrated space transportation program, this program was stopped.

And so basically is canceled at this point in time after significant investments in both time and money on the part of both companies.

And so if you look at these things and, again these are just three of many ongoing programs in space propulsion today. But you can draw some general conclusions.

One, there is tremendous over-capacity. You know, we have all suited up for a market that didn't materialize, so our factories are certainly not operating efficiently. We are not covering the costs of investment.

The tremendous competitive pressures, both domestically as well as internationally, are driving us to prices and things to be competitive, that are just beyond anything that we have ever experienced.

And, certainly, given all those other factors very, very difficult for any of us to show a profit. But to stay in the business we are taking things that, you know, probably ten years ago we never would have dreamed of.

Fix price programs for development, possible schedules, these are becoming characteristics that are not, you know, once in a while. They are becoming expectations at this point.

And I guess that can go on for a while. But we finally reached the point, I think, where the corporations now are looking at these things, and looking at the returns, and stepping back and saying, you know, that is enough, we just can't -- we won't be in business if we continue to take these type of programs.

Another thing, as we learned on the Atlas program, and also on the X-38 program, when you have a fixed price program, particularly a development program, how you resolve a development issue, especially when most people have worked on government programs is very challenging, you know, when is enough enough.

And that has certainly been an interesting thing to face over the last few years. There is little tolerance for failure. You know, people are terrified, you have a small development problem and you are worried how is that going to get out, what does that mean?

When if you think back 10, 20, 30 years ago, that is how you learn things, that is how you did develop and press the state of the art. Today you have a little hiccup, which is fully explainable and you are going to learn something from it and you are, like, oh God, is my program going to be canceled? Because that is the -- that can be the response, has been the response.

This next bullet, you know, there haven't been a lot of rocket development programs over the last 10 or 20 years. There has been work, but not a lot of true development programs that start and actually bring something into production.

What we have experienced at Aerojet, both going through the SRM program, and as we were experiencing on COBRA was the cost of rebuilding skills and capabilities. I mean, the people are smart enough, and they know rockets, but the basic infrastructure wasn't there any more.

Specialty skills were assigned to other things, or codes forgotten, and had to be rebuilt. And that cost has been, you know, significant. And as you look at the demographics in the industry, that will only increase, you know, as we go forward, unless something is done.

And another thing that is an interesting thing to observe, you know, standing back -- and some of the younger engineers, and I kind of feel old saying that at this point in time but people in their 20s and 30s, many of them have never experienced a true development program that actually results in producing and delivering a product.

And some of these people, as they work on these programs, they are putting in cost estimates, and so forth, and they are not grounded in reality. And so, you know, really that lack of development and that experience is really starting to affect the industry.

Next chart, please. And so looking toward the future I think, you know, it is not a secret to anybody in this room, space is not a growth market at this point in time.

I think we are all hoping that things have flattened out, we are hoping the corner is going to get turned in the next few years. But, at best, we are seeing a flat launch market, which drives so much of our industry, for the next few years.

One of the things that even with a flat market, that could be a problem, is we all did some buildup for EELV in the launch market, were producing at a higher rate than things are being launched, so there is inventory buildup.

And there is a constant pressure there between how much inventory does someone want to hold, versus keeping your factories going at some minimal rate.

There are exciting things being talked about, and contemplated, with reusable vehicles, SOP, NGLT military space, responsive space. All those things are great if one of them would ever happen.

You know, one of our biggest concerns is the fluidity in the government planning, and the lack of commitment to a, you know, the next mission, or the next architecture. It is going to just keep this chaos here for the next few years, or worse yet, start and stop again which is -- I mean, at least it is work, but it certainly also has some fairly negative effects.

And then, as I've mentioned, there has been heavy investment in this industry, over the last few years, I think, by all of us sitting up here. And, you know, from a corporate standpoint, you know, space is certainly not looked at as the best of investments.

You know, as I compete and try to grow space business, I have missile defense and other things, which are real positive, they look like growth industries, and that is where we will be putting our technology, which is good from some aspects.

But from maintaining a space critical set of competencies, or furthering that technology, it is not good.

Next chart, please. And I have a chart, and I did not coordinate this with Oren, I didn't coordinate with any of these guys, but you would think that we all got together and came up with this story.

But I think this does show what we are all facing, and it is a common problem. You know, the industry is certainly aging. This is some Aerojet demographic data with the purple being 1999 and the blue being 2003.

And though the employment has been pretty constant, it is basically the same people, and we are getting older. The average age is approaching 50 years old.

I mean, they are great people, real experienced, but there is significant loss of capability possible in the next few years. And, you know, whether or not we are going to have a constant enough base and can bring in young people to learn from those people, is a big question mark.

We are in danger if the sales and the base don't go up, you know, we get to be smaller than we are. The ability to transfer that knowledge is somewhat precarious.

And we are finding that there are fewer and fewer people even interested in coming into this because of the cyclical nature. You know, as we dealt with our COBRA build up we attracted some wonderful young engineers, some people right out of college.

We had them there for a year and a half, and when COBRA ended, you know, we didn't have jobs for everybody and the first ones to go are the real young guys. And so that is bad from just about every perspective you can imagine.

Next chart, please. So to conclude, you know, I think like I said companies will figure out how to survive. I mean, there are ways to survive. You change your mix of products, you shift your businesses.

But what we could lose is the true ability to develop new space products and advance our technology. These, the current type of programs out there, in the commercial industry, you can't have people

-- you can't carry your specialists on it.

You may need them a time or two, but you certainly don't need the infrastructure or cost structure to carry those people that were so critical during the development.

So you need to find other places to put them, and assign them to other things. If there aren't programs like that, and they are not adaptable, you could lose that skill.

It is unfortunate that government programs have been unstable. Many of the new technology, new system programs are unstable. Because I really believe We've minimized the learning that we could have had over the past few years.

There has been some good opportunities, but the start again, stop again, means that you put all this time and money, and investment into people, and then what do you have to show at the end if you don't actually get there?

So We've put a lot of money in, and many of these times we didn't get a whole lot back for it. And then also as I think one of the previous speakers mentioned, you know, engineers want to work on something that is new, and they are going to see their product being turned into something.

When the things stop and start again, there really -- it isn't an incentive for them to want to be assigned. So your best people, you know, are not real interested in space. You know, you look toward missile defense programs, and programs that are potentially being fielded, and that is where they would rather go.

And, as I mentioned, the corporations, they are going to invest in our businesses, but space is not looking like the area that they want to invest, you know, especially over the last four to five years.

You know, we thought long and hard what are the, you know, the ways to come around this. You can diversify the company and keep the sales base up, and keep the company going. But in terms of maintaining the space capability, I really believe there has to be a long-term government commitment to do that.

Thank you.

(Applause.)

MR. McMONAGLE: As much as I feel unqualified to represent the RS-68 engine, I would like to say, however, that there are many parts, of all of the presentations that have been given here today, that I could represent.

I think there is a common theme, and it is a very sobering theme, that is consistent across all of the space propulsion companies.

I would like to take just a brief moment before I talk about one of our successes, and then talk about some of our challenges, to mention Pratt & Whitney, as a company, has been in the space propulsion business since the late '60s, where we began in the upper stage cryogenic engine activities, as well as some of our solid rocket motor activities that took place out in our San Jose facility.

We operate facilities in West Palm Beach, which are largely liquid propulsion, and hypersonic propulsion systems. And in our San Jose facility we have solid rocket motor propulsion systems that include the Minuteman propulsion replacement program.

To represent how small this community is, we can share that many of our activities are in concert with the other three companies that are represented here today.

One of our recent successes was with the final build-out of the space shuttle main engine turbo pumps that we built in concert with Rocketdyne in their integration into the space shuttle main engine.

We are working, currently, with ATK on the propulsion replacement program for the Minuteman stages II and III. And until last fall we had a very successful program moving forward on the COBRA cryogenic engine development with NASA.

And, unfortunately, NASA's change in strategy opted not to continue that program, which is a difficult situation that put both, I believe, Aerojet and Pratt & Whitney out.

Let me mention one success we did have, that has been a success in development over the last several years, which is the RD-180 engine that we have successfully provided to Lockheed for launch on the Atlas V mission as of last August.

To go back into a little background on this engine, in the early '90s General Dynamics was interested in pursuing some Russian technology applications for the evolving Atlas program.

When General Dynamics merged with Martin Marietta, and then later in 1995 with Lockheed Martin, they held a competition, and Pratt & Whitney, and NPO Energomash, and Kimki, were selected to modify RD-170 engine, which was then being used on the Buran-Energia combination, and produced the RD-180 for application on the Atlas III and Atlas V vehicles.

In 1997 we formed a joint venture company called RD AMROSS, to staff and self-light RD-180s and launch services to Lockheed Martin. And that development has, and certification program, has resulted in three successful launches of that engine, two of them on Atlas IIIs, and then on the -- one on the Atlas V, and could be available for the Atlas V.

The combination of NPO Energomash, and Pratt & Whitney space propulsion has been a symbiotic one. Pratt & Whitney space propulsion with strength in the upper stage engine background, turbo pump developer for SSME, and we provided the funds for the development of the RD-180 engine.

Its integration and launch services are provided for us, by us, and then co-production is intended for the RD-180 in this country.

In the NPO Energomash side, they were and are a premier LOX kerosene, LOX rich fuel combustion company, rich engine heritage in that area, and I dare say that the Russian evaluation in hydrazine, I'm sorry, evaluation in hydrocarbon kerosene development has gone on, uninterrupted, over many years.

And they are very well engaged in that technology, and have successfully demonstrated it with a multitude of ground and flight demonstrations.

As I mentioned earlier, the RD-180 is an evaluation of the -- of technology that was already available in the Russian architecture. The RD-170 engine had demonstrated on the Buran capability for engine of roughly twice the thrust of the RD-180.

In effect the RD-180 is an RD-170 engine cut in half for the propulsion desired for the Atlas V series of vehicles. It is a two chamber version of what was a four chamber RD-170 engine. The scaling represented low risk in its evaluation.

And because of its heritage much of the testing and demonstrated technology that was done in the RD-170 is applicable to the RD-180. The RD-170, as part of the Buran system was developed with the intent for man-rateable and reusable capability.

Next chart. The remarkable part of this is it was taking effective technology off the shelf and developing it in a rapid fashion to develop the RD-180. And it was within approximately three and a half years from the time of selection and initiation on this program, that we were able to certify the RD-180 and then shortly thereafter launch it on the Atlas III.

Next chart. This is the family of vehicles that have been demonstrated, so far, with three successful missions, and the RD-180 engine has performed flawlessly in each of these three demonstrations thus far.

Now let me talk, for a moment, about the challenges. And much of this will be a reiteration of what you have already heard from several of my colleagues.

Obviously a demand for commercial space launch is down, the demand across the board is down. The providers are operating well under 50 percent of their capacity. In many cases, in some areas, we are operating at 25 percent, others you've heard, I think, 35 percent.

But in general we are in that range of 25 to 35 percent of capacity. That may even be optimistic in the years that follow. With that kind of overcapacitization something has to happen.

Also, much of the space propulsion market now is overseas. And it is approaching almost a parity of having overseas markets almost equal to the domestic markets in the United States.

We are having difficulty in being to approach those markets. I would like to steal one of Byron's slide, in that he shows how we are bringing technology into this country, but we don't have access to the external markets that could be available to us, because of restrictions in licensing, or ITAR, or restrictions on foreign investment.

Foreign governments, as a result of us not being able to share, or provide technology overseas, are developing that technology themselves. As they continue that development, they will satisfy their technology needs, and the gap that we have, which represents our leadership in this country, will begin to erode.

And that will continue to progress to the point where there will be no need of what our technologies are, if we are unable to access those markets.

I suggest that it is in our best interest to be able to access those foreign markets, and deliver some of that technology, where we could, overseas.

Given that, if we go to the next slide, I would offer that one potential model that we could follow would be foreign military sales. Whereas in the military industry, for aircraft and jet engines, there has been a mechanism set up for exporting to foreign countries, in a fashion that provides them with the capability, and we retain the industrial base, and the licensing in the United States.

If we could do this with appropriate metering, and provide that technology that would otherwise be developed in those countries, the difference in the technology we share with our overseas competitors, versus the technology leads that we would maintain in the country of the United States, are probably roughly equitable.

Such that by doing this we maintain our industrial base, we maintain our strength, and we allow ourselves the ability to keep our leadership in that industry, while sharing it with foreign entities.

We also incentivize them not to invest in that technology development, in their country, and retain that technology in our own country. Leveraging our comparable, or competitive advantages, in foreign markets is in our best interest.

It retains our U.S. industrial base, and it also preserves and extends our leadership going forward. It is in our best interest to look at comparable advantages, where we have a comparable advantage in this country, over foreign countries, we ought to be able to export that.

Where there is a comparable advantage in one of our foreign companies, where we can work out a mutual reciprocal relationship, or have comparable advantages applied on a global scale, that is an economy that will work, and provide the best in both worlds.

I would like to conclude by just making a personal comment. My background in the -- was with many years working with NASA, and having the privilege of associating with many of the astronauts in my training, in flying with some of them, and knowing some of the ones that were on the vehicle a week and a half ago.

I would like to add, from a personal perspective, that for us not to continue to pursue this technology, for us not to continue to pursue space, would be I think a slap in the face of those who have dedicated their time, and may have taken the risks to continue that evaluation in this country.

Not just the astronauts, but also the NASA team, and the industrial base team that works with them to progress forward.

And I would have put in a plea to this country to keep the cause, as President Bush has said, keep the cause alive going forward. And let's see how we can invigorate, and reinvigorate, stimulate our country to take this challenge and go forward, and not shrink from what otherwise would be our continued greatness in this arena.

Thank you.

(Applause.)

MR. SIETZEN: Before we take your questions I have an observation of my own. And that is, are you frightened, did this scare you? Good.

It has been very difficult, over the course of -- these are not new issues. It has been very difficult, and very frustrating to get people's attention about this problem, because it requires long term planning, which is not something that we are known for.

The Walker Commission was so important last year because that is one of the conclusions that it made. How did Bob Walker describe this? This is a call to arms for an industry in crisis.

Sadly we got everybody's attention all right, on Saturday February 1st. The question is how long are you going to keep it, and what do you do with it while you have it?

And what this panel represents is the crown jewels of this country. It seems to me to be ridiculous if you are going to ask students to go through graduate school and rack up enormous amounts of student loan debt, so that they get out of college and you tell them, well we don't have any jobs for you this year, you have to go abroad.

Our actions don't seem to match our rhetoric. And the rhetoric that you heard on Saturday, ten days ago, was how wonderful, and important, and critical this is. Well, it is.

So what STA hopes is that this discussion today is the beginning of a national conversation about space transportation. And if we really think it is as important as we say it is, what do we have to do to reverse these declines that have been described in such detail.

Are we going to wait until 2006 and we have nothing left? What an absolute disgrace that would be. And all of these things that kids see in movies about space ships that wheel, and turn, and fly, are going to be just in movies.

And who will we have to blame for that but ourselves? So let us start this conversation in this country. When the President's National Space Transportation policy comes out, whenever that day may be, let us continue this process of trying to make the case, that no matter what you want to do in space, whether it is military, or civil, or commercial, whatever satellites, whatever payloads, it all starts with a launch vehicle.

And if you really want assured U.S. access to space, some day the characteristics of that vehicle will have to be a fully reusable system. And you are not supposed to talk about that, because there is a 40 or 50 billion dollar price tag attached to that, and everybody freaks when they hear about that.

It is a lot of money, it is about ten percent of the military budget. It is an aircraft carrier battle group, and a couple of submarines. That is a cavalier way to look at it.

But the idea that this country cannot afford to sustain this industry is nonsense. It requires a priority. It requires the national command authorities to give it that priority, which requires people to talk about it, and whatever the options are.

It is not an option to get rid of the shuttle. It is an option to manage the transition. Because when you give up that 15 by 65 foot payload bay with the robotic arm, and the ability to bring back payloads, once you give that up it is gone for a long time.

So before we do anything along this road, let us at least figure out what we want to do, so that we don't find ourselves in the situation that we were in the 1990s, when it dawned on people that the biggest heavy lift launch vehicles that were in service, that could solve a lot of problems, were lawn ornaments at Johnson Space Center, and at Marshall Space Flight Center.

Those are real Saturn Vs. In today's dollars they are about three billion dollars a piece.

Let us not find ourselves in that position. Let us start this conversation.

So with that in mind, do you have questions? If you do, please identify yourself, your affiliation, and the individual to whom you would like to ask the question.

MR. DINERMAN: Taylor Dinerman, spaceequity.com, New York. I would like to ask you about evolutionary versions of the space shuttle main engine.

Are you giving any thought to a block 3, or even a block 4 version of the engine and particularly I heard that there had been some consideration given to a plug aerospace version of it.

MR. WOOD: Absolutely. As a matter of fact we suggested, in the past, that there are many things that we can do, the SSME, both in terms of operability, reliability, serviceability, all of those -ility things.

But the funding just isn't there. When you sit down and analyze what the costs are to the total shuttle program versus the mission failure risk, the SSME is one of the best bangs for the buck there is.

Today we have an engine that has flown 19 times. We have a fleet of engines that have flown at least once. And 41 engines have reflown at least once.

Many of the engines have flown at least ten times. So the capability is there. All of the data says that, you know, we could reach another level in terms of improving the reliability, the mission failure fraction improvement.

And we have suggested many different approaches to do that. Today there just isn't the funding there to do it. We have not, however, included in that a plug aerospike, as much as that sounds wonderful to me, it just does not make sense in a shuttle because the shuttle, basically, is like a stage and a half.

A plug aerospike in the base of the shuttle, today, would have issues with respect to thrust vector control, and it is just not a vehicle that is adaptable to it. When you take an aerospike you really need to make the aerospike an integrated design as part of the vehicle.

And today it really wouldn't pay out in terms of the benefits an aerospike could bring to it, because you presumably would preserve the configuration of the orbiter, as is.

MR. DINERMAN: How about in different vehicles other than the shuttle?

MR. WOOD: Well, certainly that is a

possibility. And when the SOI programs were hot and heavy a year ago, there were several options, looking at those kinds of things.

MR. SIETZEN: Anybody else?

MR. GREASON: Jeff Greason with XCOR Aerospace.

Everybody talked about the problems, I don't think those are really a surprise to anybody who is in the propulsion business. And there are sort of three things that we can do about it.

We can find new markets, and there are plenty of underfundable things, start working on that. We can hope the government starts writing big checks, and we can all estimate what the probability of that is going to be in various ways.

Or we can do something about ITAR. And, again I don't think that it is a surprise to anybody in the room that ITAR is sort of the equivalent of setting your house on fire because you are afraid somebody might break into it.

But everybody talks about that over a beer, you know, we all get together in the evenings and cry in our beer about how awful ITAR is, and how evil it is, but I don't ever see anything actually changing about it.

Can anybody, is anybody screaming? I mean, us little guys are screaming, but you probably spend more on lobbying than we are ever going to see in our lifetime.

What are you doing about it, what can we do about it?

MR. PHILLIPS: My experience has been that you can do business. Right now the Japanese H-II variant is flying, both Thiokol products, as well as Thiokol technology.

It is not easy to get licensed, but workable. We have, in the past, represented the Dnieper program in Russia. We are, the U.S. government required licenses for all activities, doing substantial work in Russia and Ukraine demilitarizing ICBM assets.

We will soon be announcing a transfer program to Europe. The process is not easy, the process is in somewhat, to me, a favorable position to where it was two or three years ago, because there has been a listening audience within the Congress, within the State Department.

My experience over some 30 years of doing business offshore, in a controlled product area, controlled technology, is that the going through the process has essentially helped facilitate a better business plan.

So I don't quite share, maybe the wall is so high, you can't get over it. Some times it is, and some times it is appropriate, in my opinion. Other ways, if you are willing to work hard, and going offshore and doing business is really hard. And the licensing process, I found, has helped prepare the teams to -- get in a more successful posture. That is my perception of it.

MR. SIETZEN: Anyone else have an observation? Julie.

MS. VAN KLEEK: I tend to agree with Oren in many of his comments. We have done work, both with Sacramento and Redmond overseas, and it is pretty difficult.

I think the thing that I would see, at least in the near term, is many of the products we talked about today, trying to sell those overseas in a market where they are just as hungry as we are, and it is not worth our time at this point.

I mean, I can't see Europeans, Japanese, Russians, any of them, wanting to buy our products at this point, at least in the very near future. Now, that probably is going to change as the market changes.

But in the near term, even if we could have business be a little bit easier, I'm not sure there is, you know, much benefit would be gained from that.

MR. SIETZEN: To answer the other part of your question as to what groups are doing, you don't usually hear about various aerospace groups having alternate agendas.

Here is a case where last year STA, AIAL, AIAA, NSS, all of the space organizations, trade associations, and so forth, joined with an initiative that was really done by the U.S. Chamber of Commerce Space Enterprise Council, who took the initiative and who ought to get the credit for this. And we all signed on to a letter to the President, and to the Congressional leadership, urging the export reform in terms of restructuring the responsibilities for licensing.

And all I can tell you is that at a time of war it didn't go anywhere. That doesn't mean we are not going to continue this effort at reform, because it is essential.

But you did have all of the groups that represent various elements of the space industry, or grass roots organizations, or whatever, united. Thanks to Dawn Sienicki work we signed this letter, it went to the President last spring, it went to the Congressional leadership last spring.

But, again, there were other issues facing the Congress and, hopefully, that will be solved this year, when we will get another crack at it.

Let me ask this question of all four of you. Let's play a little what if game here. Let us say, for the sake of argument that, first of all, we assume that whatever caused the 107 anomaly, they find it, they fix it, the shuttle is flying again, within a year.

And the President gets in front of the Congress next January in the State of the Union message that launches his reelection campaign and says, it ought to be a national goal of the United States to develop a fully reusable vehicle that reduces the cost of access to space by, fill in the blank. I'm not going to do the 100 dollar a pound, and we will do it in a decade, let's say.

Do you think the health of the industry is sufficient, and the resources, labor pool and otherwise, is sufficient that we could, in fact, do such a thing?

I'm not talking about an unlimited budget, but if you have a challenge like that, under a circumstance like that, could we do it?

MR. WOOD: Well, I think if it were on your time table, Frank, and he did that next year, the answer to your question is probably we do. But the time is running out.

I also really question whether with 107 being resolved, and all of the other issues, are we going to war, are we not going to war, and all those things, that the likelihood that such a statement by the President in high priority is forthcoming in a year, it is probably further off.

I look at, you know, what kind of thing could put new life into the pro business, in my view, and I root for it every day, is for the Chinese to put people in space. And if they do that successfully, and they are trying really darn hard to do it, I think that is what I'm looking for.

MR. SIETZEN: Oren?

MR. PHILLIPS: Well, I think Byron summed up what might create a national imperative that would catch the enthusiasm and support at a time where other budget pressures are going to be so severe.

You know, I'm certain that we will have a recovery project on shuttle. But it dictates being part of, I think, at least a three part plan. Spending whatever is necessary to support reentering flight with some confidence, and I don't know what that is, and I don't know how long that would be.

The second is that if we return successfully, we recognize we are going to be dependent on that transportation system for 10 or 20 years. And all of us have provided input as to what we think we would recommend be incorporated to maintain the current reliability, or enhance the reliability of that system, when in fact we are going to have three assets that we are going to have to be able to use with the highest confidence, for 10 or 20 years.

That is a program that will have to be funded. And in parallel with those, if we move to the next stage, I don't know what it will be, whether it is 40 billion, or 80 billion, with or without national imperative, that is on top of the rest of the cost.

So I think we are facing a real challenge. It would be nice to have a national imperative, I don't expect one. The reality is we are back into a deficit, we have a program that needs to be fixed, we have a program that needs to be sustained, and we also have to find a path, affordably so, to lay in the necessary technology so that when we go to the next system, with or without imperative, we are prepared to do it.

And I don't think we are there yet. So how do you balance that challenge, how do you do that with potentially a flat NASA budget? How do you do that at the same time that we have great needs and expectations to support the DOD, and parallel the homeland defense initiatives. It is a real challenge.

MR. SIETZEN: Julie?

MS. VAN KLEEK: I think to answer the first question, do we have the capability and could we embark upon that, even with that type of, with fairly aggressive time scale, which I think ten years would be, for that big of a change.

I think we have that now, I think many of the things that we faced during the last few years, NASA's SLI program, demonstrated that there is still capability in the industry.

I guess the question that I would have is it is not likely something like that could get funded here in the near term. We will have to deal with the realities of today, many of which the previous two speakers commented on.

And I'm, you know, hopeful that we will find a way to bridge that gap until that day comes when we do have to develop that system. I have extreme concern over the aging of the industry and the loss of all the capability and knowledge that exists in those people that will retire in the next five to ten years.

It is very difficult, I think, for companies to stockpile that knowledge. I mean, it certainly takes investment to do that. And one thing I think that I would hope, you know, is that the government realizes that this is a real imperative for the future, would think of some ways of stockpiling that knowledge, so that it will be available when we do embark upon that mission, which is likely to be, you know, somewhere in the future.

MR. McMONAGLE: I think today if we pursued that it could be done, but it would be at high risk. And I say that because we have, I believe, in the recent years, demonstrated that we take on major new initiatives like this, and we try to bring them to fruition, and fly them, and are unsuccessful getting to the flight stage, because we do not have the technology buckets ready to be able to support them when we get them to that flight stage.

We don't have the investment in technology that allows that grass root set of technology demonstrations available with enough breadth to create trade space when we integrate the overall system, and then bring it to the point where we are prepared to go into flight without risk.

And because we tend to create technologies along the way, because those reservoirs of technology don't exist, we put ourselves at risk in the development, and we risk getting to the point that we cancel programs because of a technology issue late in their development.

If we are wise, we will invest in the technology efforts up front, have those trade spaces available to us, though, when it comes time to integrate the trade spaces are there to provide that lower risk alternative in how we go forward.

As I say, I don't think we are investing enough in the technology buckets to be able to go forward with a program on that time scale, without high risk.

MR. SIETZEN: Yes, sir, your name and your affiliation, please.

MR. KELLY: Michael Kelly, Kelly Space and Technology.

In 1957 nobody on earth had ever placed an object in orbit. And in 1967 we launched the first Saturn V successfully. In fact, we didn't place an object in orbit until 1958, and so we had no technology, we had no expertise, no wealth of experience, nothing.

We created this from scratch, in a period of ten years. Since then we've gotten a lot smarter at manufacturing, computational prediction, etcetera. So why is it that with 50s technology we could create a Saturn V in ten years, but it would be high risk to create a new vehicle in ten years today?

MR. SIETZEN: Let me add something, first. The Saturn V was created, true, by NASA and did contain materials and elements that had not been invented at the time John Kennedy made his commitment in 1961.

But I would make the observation, to you, that the engines upon which the Saturn V was developed, the F-1, the J-2, the RL-10, which was the precursor to the J-2, and the M-1, which didn't fly, what is the common link of all of that? It was funded by the military.

Much of the technology of the early Saturns, C-1, Saturn IGB, and eventually that migrated to Saturn V under way at the time of the late 1950s, early 1950s, not because the U.S. Air Force, or the Army at Red Stone arsenal wanted to send astronauts to the moon, they wanted to build bases on the moon, they wanted to use military uses for these heavy lift vehicles.

So when Werner Von Braun was transferred from the Red Stone Arsenal to Marshall Space Flight Center, there was something for him to take with him.

I would dare say, today, that we are further away from the moon, or any other commitment that a president would theoretically make, because he doesn't have that base, that R&D base that John Kennedy inherited, and Werner Von Braun inherited, and Jim Webb inherited, because of other investments that were going on.

Which is why the point that was made so much today, by all of our speakers, and that is the deficit of R&D we are at the lowest amount of a percentage of federal R&D research in 40 years. That is the base on which you build commitments.

So I would tell you that my personal view, not being a rocket scientist, I'm the only one here that isn't, that would be one reason.

Does anybody else have an observation as to why we are so far away? Byron, you've been around, you know.

MR. WOOD: Thanks. Yes, Frank's kind of got it. You know, back in the days that F-1, J-2, so on and so forth, started, at Rocketdyne, which is when I hired in, we had 22,000 people working there on ICBMs, IRBMs.

We had 17 test stands operational in those days. We had 30 laboratories devoted to materials testing alone, all over the country. We had this huge installed base to take the project on. If you look at -- if you saw one of my charts, if you look at a J-2, or an F-1 in today's dollars, those engines cost three billion dollars a piece to bring to the point of first flight.

So for a new Saturn V that would be at least six billion dollars in engine development to a first flight. Today everybody chokes on anything that is more than a billion.

So I don't look at it as a matter of could we do it. It is that I frankly don't believe that the country either mentally, financially, or motivationally, has the wherewithal to take it on. And so it is not going to happen.

MR. SIETZEN: Any other questions? Yes, sir.

MR. BAHN: Pat Bahn, TVG Rockets. In every field the technical endeavor I have ever worked with, and associated with, things start off winning Nobel prizes. And within 5, or 10, or 15 years, you've got high school kids demonstrating this at science fairs.

You know, in the mid-1970s gene splicing would win you the Nobel prize. By the late 1980s you would see those showing up at the Montgomery County science fairs.

In the early 1950s and '60s numerical analysis methods were cutting edge. By the 1970s and '80s these were things that every undergraduate college student was doing.

What is wrong with aerospace that the things that are cutting edge still remain, you know, undoable by the primary industry, the information and the technologies, and capabilities aren't flowing down and democratizing.

You know, what is stopping this happening in this industry?

MR. SIETZEN: Do you want to take it?

MR. PHILLIPS: A lot of reasons, but one of them -- the overall reason is money. When I started in this industry the first program I had was a quick development program to provide the upper stage for what was then the precursor for DMSP.

A classified program, I had one test go, nobody would ever know we flew it. And I turned to my team and I said, I don't know where to start. And they said, it is really easy, we just test 57 of that configuration for the Surveyor Lander.

Here is all the material characterization data that has been done over the last ten years, funded by various NASA, pre-NASA, National Science Foundation efforts to the tune of millions and millions of dollars on ablative and visco-elastic materials.

You know what? There hasn't been any of that work done since then. That is where we are short. The other thing we are short on, and while we've gotten away with some of the things in the last few years, is that all of us in this industry, dedicated to success the first time out of the barrel, have been able to reach, on every development, every qualification inside our company, inside the agencies, and inside our competitors for help, to make sure that we were using all the grey knowledge that had gone before, to be successful.

We are three years or so in with Pratt & Whitney on rebuild a Minuteman. We built the Minuteman first stages 35 years ago. Fortunately we videotaped, not videotaped, we filmed 16 member, an interview of that team as they were let go at the end of production, 35 years ago, and we found a few of them that were still alive.

That became our technical resource to start the program. There are the challenges we have. Yes, numerical processes, ability to provide analysis is greatly enhanced. Run by people who have never seen a development program, let alone a carcass of a failed product, never been part of the development project. Talented people, no experience.

MR. WOOD: Well, you kind of hit on it a little bit. Today the world won't accept failure. I remember as the development engineer in J-2, back in the '60s, I blew up three J-2s in one day.

And today if I blew up one I would be on the street. After the second one the company would be on the street. We just have got a society, or a premonition, or presupposition that what we do, because we have all these tools, and all these capabilities, and kindergarteners are doing Nobel laureate kind of work, that what we turn out is going to be perfect.

And so we are risk aversion mongers, okay? We take the high road, we take the long path, we take the conservative approach, and all those things, or the antithesis of all those things is what took us to the moon.

MR. SIETZEN: One more question.

(No response.)

MR. SIETZEN: No more questions. Thank you very much Byron Wood, Oren Phillips, Julie Van Kleek, and Don McMonagle for taking the time to come here today, and to initiate this process, which we hope will lead us to a stronger, healthier U.S. based transportation and propulsion industry. And thank you very much for staying.

MODERATOR MURRAY: Thank you, Frank. I have a few announcements. We have some forms that look like these, in your folders, your conference folders. And it is a conference evaluation, and there are also attendee information.

And if you don't have these, or if they are not in your folder, I have a few copies, and the people at the desk have a few copies.

One of the things that we are going to be doing new this year is the proceedings, they are going to be electronic, either on CD or DVD. And if you could maybe indicate your preference on one of these sheets, preferably the one with your name on it, then we would know which one to send you.

And the other thing that we have left, before we finish, is some closing remarks by AST special assistant for programs and planning, Calvin Coleman.

MR. COLEMAN: My closing remarks really boil down to an announcement, a short message, a brief observation, and a few thank yous.

First the announcement is that normally standing here before you at the close of the conference would be my boss, Patti Grace Smith, the Associate Administrator for Commercial Space Transportation.

Unfortunately she could not be here, she had a last minute commitment that she had to keep, so you get the second team to close out.

The message is carry on. This conference is a tribute to our seven fallen heroes, in their memory we must carry on. Space is important, it is our livelihood, we must continue these dialogues, we must continue these discussions, we must continue to face the challenges of space, and never quit.

We all fell 10 days ago, but as we always do, we get up. I think this conference, and the discussions that we've had over the last two days, demonstrate our willingness, and desire, and courage, and need to get up and to continue.

And my observation is that we are getting up, and we are continuing, and that is a good thing.

I would like to thank all of the panelists who came before us. I would like to thank all of the speakers who came before us over the last two days, who challenged our minds, provoked our thoughts, and pushed us ahead.

Bob Triplett, Tim Huddleston, Lt. Governor Mary Fallin, Professor Kubota and Ms. Onuki from Japan, who came -- their presence certainly demonstrating that we have a global partnership in pushing space transportation ahead.

Gil Klinger, Frank Sietzen for coming, and many others who came and shared with us their thoughts, and their ideas over the past couple of days. It has been a great exchange.

I would like to also thank members of our own staff in AST, Jay Garvin, Ken Wong, Laura Montgomery, Chris Draper, Hugh Cook for their contributions in moderating the panels that we had, and leading us in those discussions.

Our master moderators, Michon Washington on yesterday, I don't know if Michon even introduced herself at all, yesterday. But she has a day job as our environmental specialist, she does an outstanding job for us in that respect.

Michelle Murray today who master moderated, she also has a day job at AST, as one of our outstanding aerospace engineers, working on new space system development projects.

And all the rest of the staff who contributed. One more person we need to thank and he is sitting in the back of the room, looking inconspicuous. Chuck Kline, could you stand up, Chuck?

Chuck is an invaluable resource to Patti Smith, and all of the rest of us. I guess you can tell by the color of his hair that he brings lots of experience to AST. He has honchoed this conference, and pulling it together for us for the last six years.

And every year it has been a tremendous success. And I think that reflects the dedication and the hard work that Chuck has put into this. He keeps hinting around that this is his last go-round, but he hasn't let the cat out of the bag yet.

But I do want to say to you, on behalf of all of us at AST, on behalf of Patti Grace Smith, thank you Chuck, and we appreciate what you've done, and we appreciate what you have done for space transportation in this country.

And lastly, but not least, thank you to all of you for coming out and participating, and continuing the dialogue, and continuing the discussion, and continuing to face the problems and the challenges that we have that lie ahead of us in space transportation.

And we hope that when we meet again next year at this time, that we will have a good story to tell, and many successes to look back on over the past year. So, with that, have safe travels to your homes, and we thank you.

(Whereupon, at 3:56 p.m., the above-entitled matter was concluded.)